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CANADIAN GEOGRAPHICAL JOURNAL

Editor - WILLIAM J. MEGILL

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Canadian Government Travel Bureau

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The British standard of spelling is adopted substantially as used by the Government of Canada and taught in most Canadian schools, the precise authority being the Concise Oxford Dictionary, fourth edition, 1951.

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Drama in the Wilderness

by FREDERICK A. CURYLO

THESE pictures of a battle to the death between a snake and a frog were taken in the Luther Marsh in Ontario with a telephoto lens while the author was waiting for some Canada Geese to appear. They tell their own story in a most dramatic way; it is the ageless story of the struggle for survival that occurs constantly in nature.

* * *

(1) Slowly, menacingly, a common garter snake approaches a frog by a cool spring stream. He will endeavour to overpower and swallow his intended victim bodily, even though the frog appears too large for his gaping jaws.

(2) The snake having seized the frog suddenly by the head, a fierce battle begins, but the powerful jaws hold on to the struggling frog until it submits in utter exhaustion.

(3) Opening his jaws to their fullest extent, the snake tries desperately to swallow his victim.

(4) The ensuing battle carries both reptiles into the nearby stream. The snake tries desperately to stay above the water with his heavy burden.

(5) Feeling the cool water on its body, the frog makes a desperate effort to free itself with a sudden surge of breath and vitality.

(6) Breaking free for a moment but stunned and very tired, the frog is again quickly and expertly seized and enwrapped in a coil. Having again secured his position on the log above the water, the snake begins to uncoil, but feeling his victim slipping from his grip, the persistent snake makes a sudden lunge to repossess his struggling quarry.

(7) Once more the hungry reptile takes control of the situation and proceeds to swallow his victim in a hurried fashion.

(8) The outcome of the battle is obvious. Still kicking feebly, the frog begins to disappear into the gaping jaws of the snake.

(9) The battle ended, the snake, now visibly tired from the long ordeal, can barely move or lift his head. After a few minutes rest, the snake slowly slithered off to a secluded place under a stump to await another day.

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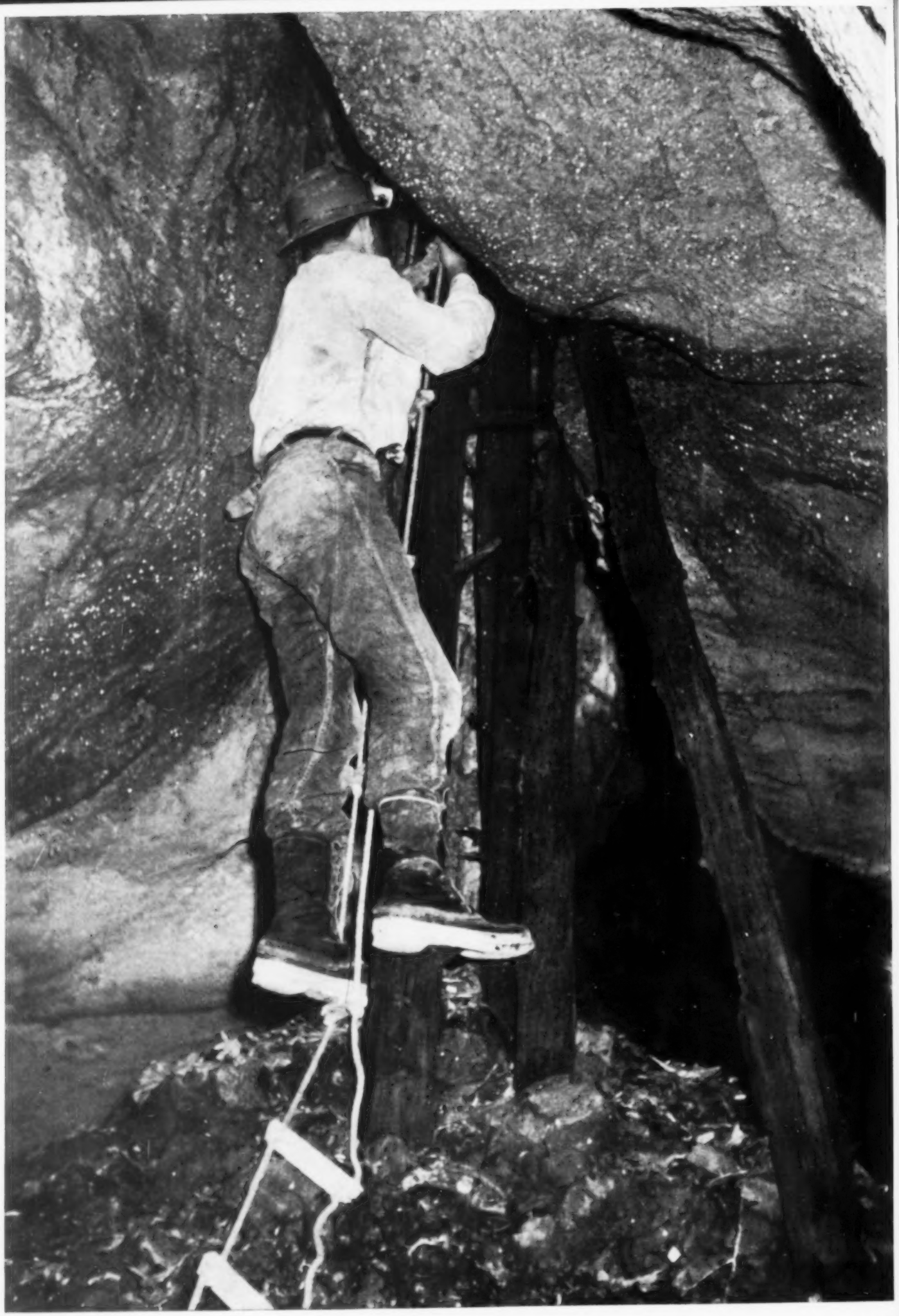


Ontario Underground

by JON N. WEBER

Photographs by the author

RARELY does the mention of a cavern nearby fail to excite the interest and curiosity of the young and adventurous in any community. These holes and crevices in the earth's crust are often merely empty pits and passageways leading nowhere, floored with mud and presenting numerous hazards such as the loosely fastened slabs of rock which form the ceilings. Yet there are always those who crawl through the keyhole passages and lower themselves into pits, obeying some irresistible urge to discover what mysteries lie ahead, past the reach of the flashlight, around the next corner or in the next passage.

The beautiful caves of the karst regions of Kentucky and Virginia or of England, France and Yugoslavia are well known and are so much publicized that many never realize that caverns occur in most parts of the world, often right at home. The caves of Ontario are not large, nor do they contain an overabundance of beautiful and massive calcite stalagmites and stalactites which the more famous caverns possess. Nevertheless the occurrence of a number of different types of caverns in Ontario, some choked with small but beautiful calcite deposits, others providing homes for various forms of cave life, is certain to attract the amateur naturalist as well as the week-end adventurer.

The equipment required to explore caverns depends a great deal on the type of cave encountered. For cave entrances located near the top of bluffs or containing sink hole passages, a hundred foot rope ladder or rappelling rope is often useful. In most of Ontario's caves, however, no ropes of any kind are required.

Hard hats or close-fitting plastic helmets provide protection from low ceilings and from various calcite projections of the roof. Light is best obtained from electric torches using flash-light batteries or from carbide lamps which emit a one or two inch flame of burning acetylene gas which adequately illuminates even fair-sized chambers. Carbide lamps, which are available at some hardware stores, require refueling with a small charge of water and calcium carbide every three or four hours.

The caves of Ontario are too small to present any major hazards other than the dislocation of loose rock from the ceilings. Air is generally pure, pits are shallow, inhabitant animals are usually quite small and various disease bacteria prevalent in the guano deposits of more southernly caves are absent. In general, the caves of Ontario present few hazards to exploration except perhaps the prolific growths of poison ivy covering the entrance passages of most of the Bruce Peninsula caves.

Ontario's caves have attracted the attention of writers very little, possibly because the true beauty of many of them was not widely known. Sir George Gibb in 1860 mentioned a few caverns from Labrador to Lake Superior but many of them were insignificant and the list was by no means complete.

The most interesting caves are perhaps those at Rockwood just a few miles east of Guelph. In the vicinity of the village of Rockwood lies a gorge approximately one mile long and $\frac{1}{6}$ mile wide trending about NE-SW. Here the Eramosa River has cut 40 to 60 feet through the light grey dolomitic limestone of the Lockport formation. Large masses of encrinite, a rock composed of the calcite stems of ancient sea-lilies or crinoids, form some of the cliffs, and the numerous abandoned lime kilns and extensive quarries indicate that the rock was once used in the preparation of lime and building stone. Many stone buildings and houses nearby are constructed of material excavated there.

Ten caves worthy of consideration occur here along with many more of lesser interest. Only three caves, Rockwood, Richardson's and Pierre's Caves will be described, as they are typical of other caves in the immediate vicinity.

The entrance to Rockwood Cave, number 2 on Figure 2 is an opening 10 feet high occurring at the base of a 50-foot cliff of dolomitic limestone. The first recorded visit

Using a rope ladder to penetrate the depths of crevice caves in the Niagara escarpment.

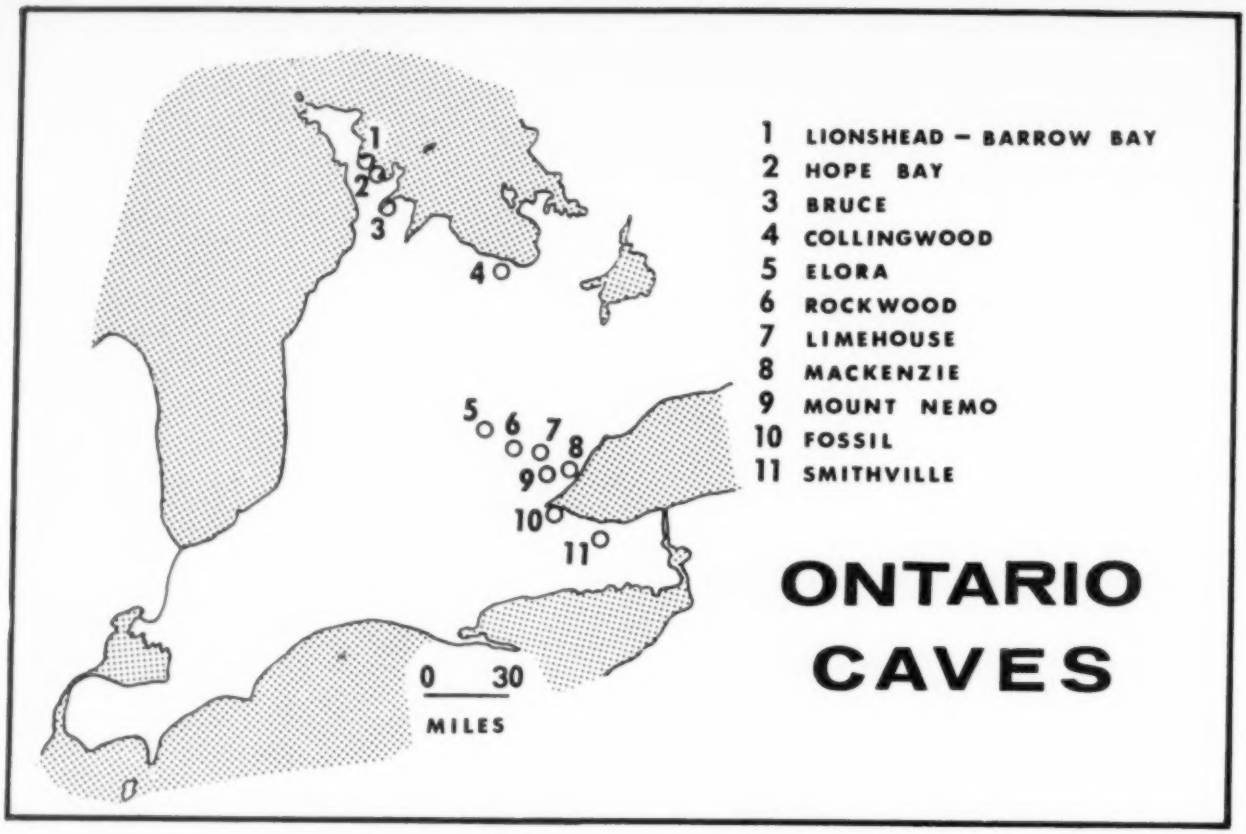


Figure 1. *Map showing the locations of the caves of Southern Ontario.*

was made by Professor J. Hoyes Panton, a geology instructor at the Agricultural College nearby, in 1887. His exploration of the area, for the purpose of showing his students examples of how water acts upon limestone, outlined a number of interesting caverns.

The total length of the entrance passage to Rockwood Cave is 168 feet. Two chambers are present, an entrance room 6 to 7 feet high and a second room 4 feet high which is connected to the entrance passage by a crawlway 1½ feet in height (Figure 3).

The floor in most places is wet chocolate brown mud. Excavations in several parts of the cave indicate that this mud layer, which is commonly very compact, has a thickness that varies from several inches to more than one foot. Blocks of rock which have been dislodged from the ceilings are scattered throughout the cave; the largest one, several feet in diameter, is situated in the centre of the second or inner room. Seventy-five feet from the entrance, two passages of short length extend perpendicular to the trend of the main passage. Forty feet further another crawlway leads off to the right and is parallel to the first side passage.

Water drips from the roof continually, especially in the inner recesses, and small pools of water an inch or so deep occur at various places along the floor. Stalactites, white or brownish calcite projections from the ceiling, are numerous in the inner passages and may attain a length of 3 or more inches. Examination of the ceilings of the outer entrance passage suggests that at one time many stalactites and calcite encrustations adorned this chamber also. However, the numerous visitors to the cave over a period of many years have no doubt been responsible for their disappearance. Panton describes stalactites a foot in length and up to 4 and 5 inches at the greatest diameter in the innermost passages but these have now been removed. However, stalactites up to 10 inches in length may occasionally be unearthed from the chocolate brown mud at various points in the cave. Both the massive variety and the delicate "soda-straw" stalactites are found.

Several poorly developed "helictites" or worm-like stalactites have been discovered along with small patches of "cave coral", a botryoidal or grape-like growth of calcite. Flowstone is fairly abundant in Rockwood Cave and forms "bacon rind" ridges and other encrusting outgrowths along the cave walls.

Because of frequent human visitors to the cave, troglodytic animals have been driven

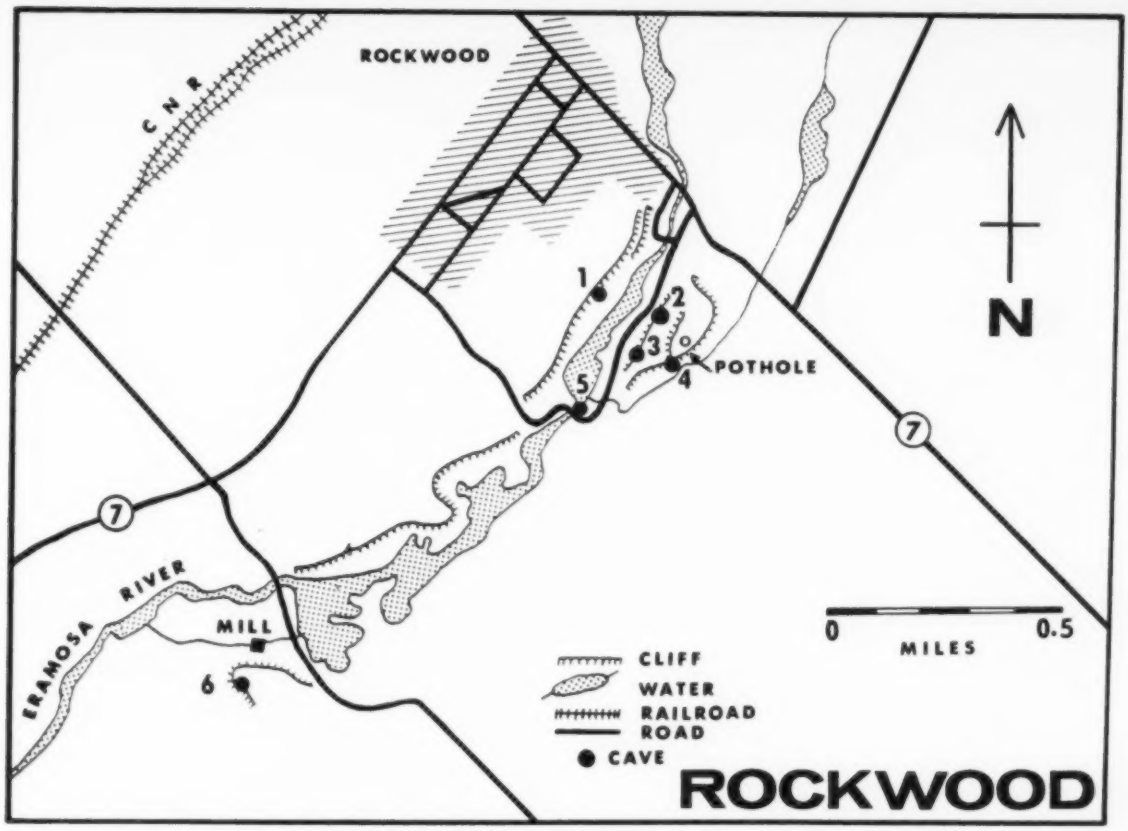


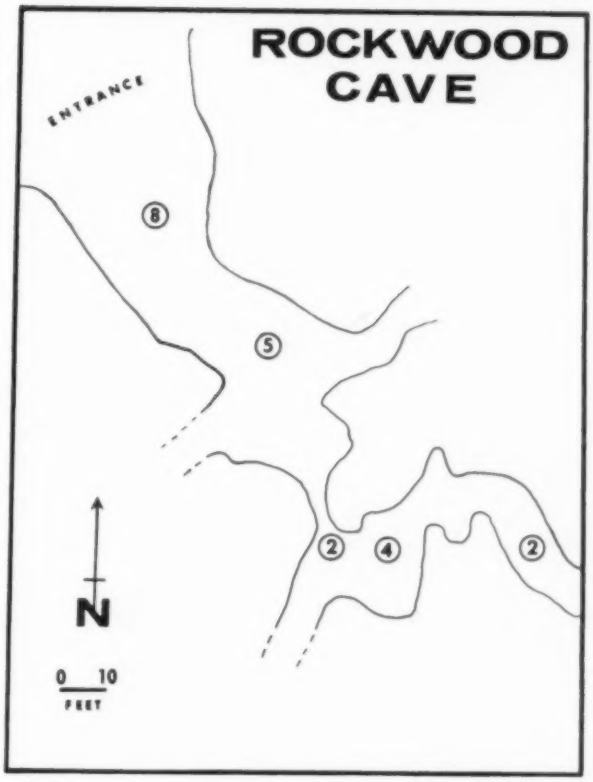
Figure 2. *Map of the Rockwood area showing locations of some of the larger caverns.*

out to the many smaller caves of the region. Bats are unknown in this particular cavern but spiders frequently inhabit the entrance passages which are much drier than the inner portions. Animal bones are occasionally exhumed in the main passages and these consist largely of porcupine remains.

Dr. Panton, who first described the area, postulated a passage running under the inner chamber of the cavern, for when the mud floor is pounded, a deep hollow sound is emitted. This results, however, from the plastic consistency of the mud covering of the floor and the echos produced in the closed chamber. Excavation reveals solid rock below.

The cavern owes its origin to several features of the surrounding countryside. Geological ages ago, forces within the earth's crust compressed the rock strata (figure 6) forming a broad dome or small anticline at Rockwood. The forces acted from the north and from the south, forming the elongate fold which trends roughly east-west. When rock is compressed in such a manner, two sets of fractures develop with numerous subsidiary fractures parallel to the major ones. These fractures, called conjugate joints, are minute fissures in the rock, incipient crevices where ground water may enter and slowly dissolve away the limestone, thus forming underground passages. Some of the limestone is precip-

Figure 3.
Plan of Rockwood Cave, at Rockwood, Ontario. Ceiling heights in feet are indicated by the circled figures.



Outcrop of dolomitic limestone showing the dip of the strata on a flank of the Rockwood anticline.

itated, forming beautiful stalactites or stalagmites within the cave, but the bulk of the rock is carried to the rivers in solution and finds its way into the ocean.

The NE-SW and NW-SE joint patterns produced by localized pressures in the crust are responsible for the "cubic" shaped outline of the plan shown in Figure 3. The beehive shape of the passages indicates that much of the cavern was excavated by ground water above the water table (see Figure 4). Had the cavern been formed below the water table where the entire rock is saturated with water, cross-sections of the passages would tend to be spherical. Much of the mud covering the floor has been introduced by small rivulets which enter the cave during rainstorms through small impassable sinkholes in the rock pinnacle in which the cave occurs. Smaller amounts of mud represent the insoluble clayey matter of the rock which remains after the more soluble calcitic parts have been carried away.

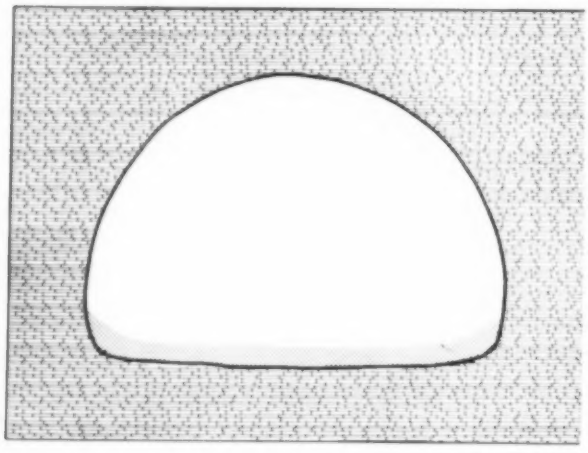


Figure 4. *Beehive shaped cross-section of cave passages at Rockwood.*

In addition to conjugate joints, a second set of fissures called tension joints (figure 6) originated at the crest of the anticline as the brittle rock was folded. These crevices provided easy access to small streams, and gradually as water was directed along these channels, Rockwood gorge (figure 5) was cut by the Eramosa River. The position and direction of these tension joints, of which no trace today remains, has controlled the position and direction of the gorge.

Richardson's Cave (Number 4 of figure 2) also in the Rockwood area has an entrance

located at the base of a 60-foot cliff in a small gorge containing a creek which joins the Eramosa River downstream. The entrance measures 2 feet wide and 1½ feet high.

The cave (Figure 7) consists of three rooms: an entrance chamber 11 feet long and 5 feet wide with a maximum height of 7 feet, a chamber to the right 8 feet by 6 feet and up to 11 feet high which is connected to the main chamber by an 8 foot crawlway and a chamber to the left 8 by 7 feet with a ceiling of only 4 feet. Large blocks of breakdown from the roof are scattered throughout the cave but the floor is covered with fine rock debris rather than clay.

Although some flowstone adorns the walls, deposits of lime are small and consist mainly of small stalactites up to 2 or 3 inches long. The cave provides an ægis for a number of brown bats and other small troglodytes. Spiders are quite numerous. Like Rockwood Cave, the plan is controlled by a set of perpendicular joints and it is possible that several passages could be extended by additional removal of clay and mud.

Pierre's Cave (Number 6 in Figure 2) is located at the base of a 30-foot cliff of dolomitic limestone. The entrance, about 1½ feet high and 3 feet wide leads to a short crawlway with two small rooms less than 4 feet in height but about 20 feet in diameter. Calcite deposits are more abundant partly because this cave is little known and more difficult to locate.

Hollow "soda straw" stalactites are associated with the usual massive variety and flowstone is quite abundant. Despite the very high relative humidity, the cave is frequented by bats and other small animals. Above the cliff, numerous channels and holes up to 8 inches in diameter lead by sinuous passages to the caves below. In winter, these holes generally remain clear of snow.

The Rockwood area is known also for the numerous and well-developed potholes which are located on both sides of the Eramosa River. The largest, locally called "The Devil's Pit" occurs at the top of the cliff in which Richardson's cave has been excavated. The pothole, an impressive sight, measures 18 feet in diameter and 25 feet deep. Although at present on a pinnacle of rock high above the surrounding valley, this pothole forms the termination of a small gorge which a stream once traversed. The hole is egg-shaped, with its greatest diameter approximately half way down. At the base is a small opening to another and lower gorge. This opening, about 4 feet high and two feet wide, permits easy access to the base of the pit. Panton in 1886 attempted to excavate the numerous boulders at the bottom and with the help of his students, was successful in obtaining several spherical "pothole grinders".

A great many smaller potholes are found throughout this area, some of which exhibit excellent form. Although several were excavated by Panton, further digging often reveals more of the spherical grinders.

Smithville cave is located about ¼ mile

Figure 5. *Diagram illustrating the position of the Eromosa River in the Rockwood anticline.*

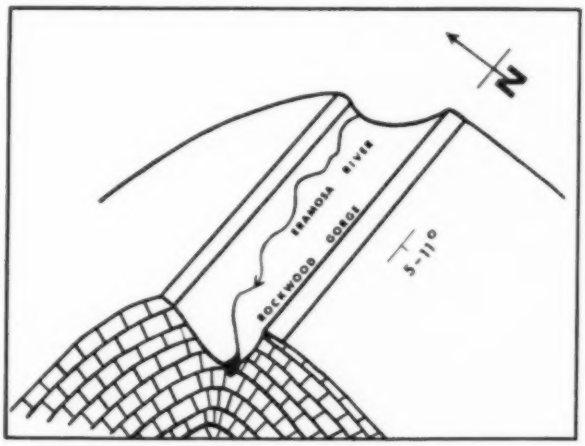
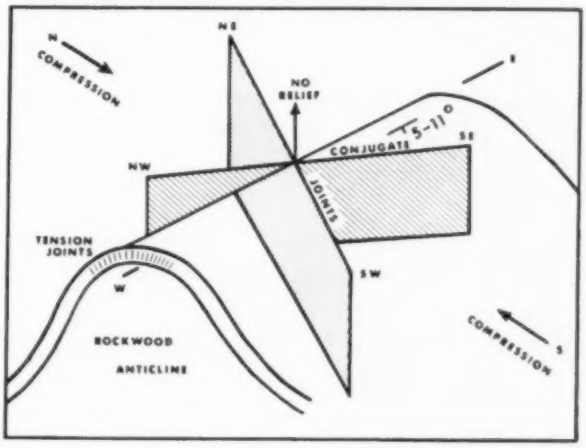


Figure 6.
Diagram showing the formation of the Rockwood anticline and the conjugate joint systems along which the caves have been excavated.



Stalactites, small curved helictites and rimstone pools with cave pearls at Hope Bay Cave.

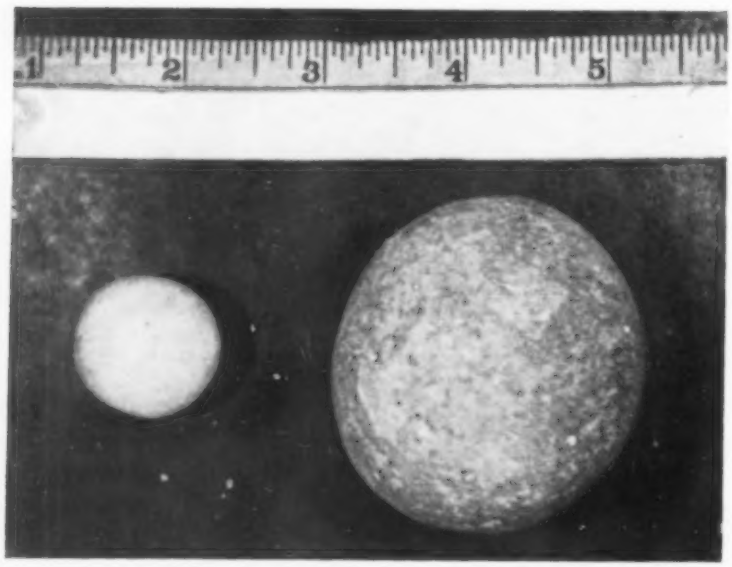
NW of the village of Smithville on highway 20. The entrance, about 2 feet wide and 2 feet high, appears at the base of a small sinkhole about 7 feet deep. The sinkhole entrance is a collapse doline formed by the breakdown of passages which can be traced several hundred feet north-eastward from the entrance. Natural tunnels are found at several places where the cave passages failed to collapse.

An active stream traverses the cavern and exploration is possible only in dry weather when the volume of water has decreased. In spring, melting snow and heavy rains fill the sinkhole, making access impossible. At such times, a head of hydrostatic pressure is created causing a fountain up to a foot in height to be ejected at the exit near Twenty Mile Creek.

From the positions of the entrance and exit, the cave appears to be at least 1,300 feet in length but only slightly over 400 feet have been explored. While the stream is only inches deep at the entrance, reinforcing rivulets from side passages increase the depth of water so that about 400 feet from the entrance, the depth is over 1½ feet and the air space above the surface of the water has decreased to mere inches. Further exploration is possible only in very dry weather.

The passage is slightly sinuous and has a circular cross-section which measures on the average about 3 to 3½ feet in diameter. Numerous side passages at right angles measure up to a foot in height and less in width. The floor is smooth water-polished rock with small pebbles carried in by the stream. Mud and clay are present only on small side-ledges, left behind by higher waters.

Hope Bay cave is perhaps the most beautiful cavern in southern Ontario. The entrance



Spherical pothole grinders taken from one of the smaller potholes in the Rockwood area.

is located at the base of a cliff which towers 150 feet over the deep blue water of Hope Bay on the eastern side of the Bruce Peninsula, halfway between the village of Hope Bay and Shoal Cove. The cave is best reached by the road north of the cave entrance. From the termination of this road, a bearing of 155° will lead to the cliff face and by following the cliff-face southwestward for several hundred feet, a talus filled indentation of the escarpment can be found which provides easy access to the base. Retracing north-eastwards along the base of the cliff on top of the talus slope will lead to the cave entrance.

Hope Bay cave is excavated in dolomitic limestone along a set of vertical joints, one of many dissecting the cliffs. At the entrance, the dimensions of the main passage are 60 feet by 40 feet but slightly over 100 feet from the entrance, the passage has narrowed to 6 feet wide and 10 feet high. Large slabs from the ceiling form the floor of the cavern.

At the termination of the main passage, a dome 3 feet in diameter and 15 feet high leads to the second level of the cave. The higher level consists of a room 50 feet long, 12 feet wide and 7 feet high trending at right angles to the main passage. It is in this chamber that the beautiful calcite deposits occur.

Helictites, the worm-shaped stalactites, are found in the western end of the upper chamber and stalactites are abundant and varied. Rimstone terraces and dams, flowstone "bacon rind" and many rimstone pools with well-formed "cave pearls" or pisoliths comprise much of the speleothem material. Most notable are the "saw-tooth" forms which occur along the walls and ceilings, individual teeth commonly being ¼ inch in height. These "teeth" are loosely cemented to the cave walls and are often found with rock debris on the floor.

The surface of the ground above the caverns is marked by large joints, filled-in sinkholes and "sunken valleys". One large doline or sink-hole about 22 feet in diameter and 10 feet deep is perfectly funnel-shaped and undoubtedly leads to caves below. Earth and forest debris, however, choke the passage.

MacKenzie Cave is unique in that it is the only cave of any size in Ontario which occurs

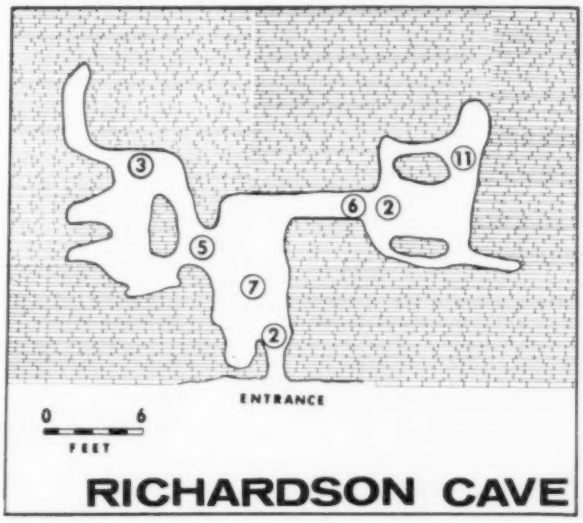
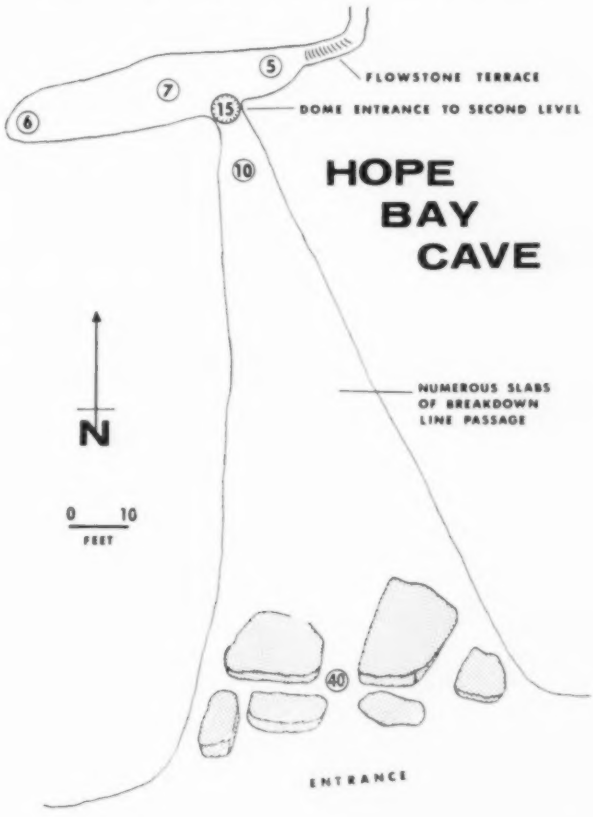


Figure 7.
Plan of Richardson's Cave at Rockwood. The circled figures show the ceiling heights.

in poorly consolidated sandstone. The entrance is found in a lens of sandstone and fine conglomerate included in the red Queenston shale along Bronte Creek about 1 mile north-

Figure 8.
Plan of Hope Bay Cave in the Bruce Peninsula.



A massive ice pillar sparkles in a cave at Elora.

west of Merton. Here, effluent ground water has excavated a passage over 60 feet long, with an inner chamber 6½ feet in height and about 10 feet in diameter. Along one wall is a pool of clear water about 3 inches deep. Small "bacon rind" stringers cover the walls. Blocks of sandstone are strewn near the entrance and in the near future, the complete collapse of the cave may be expected.

Large, deep, cave-like fissures, called crevice caves, occur at a number of points along the Niagara escarpment from Niagara to Tobermory. Normally these "caves" bear no roof, but some are covered by organic debris or large boulders, and the passages may attain a length of over 100 feet. Well developed examples are found at Limehouse, Bear's Gap, Mount Nemo, Rattlesnake Point and west of Collingwood. At Isthmus Bay near Lion's Head, a large glacial erratic has come to rest over the space between the cliff face and a pillar of rock, forming a spectacular natural bridge.

A number of picturesque shelter caves are found in southern Ontario and these consist of large hollowed-out chambers with large entrances but with few or no passages leading from the main room. Bruce Cave is perhaps the best known of these, and many a family outing comprises a Sunday afternoon excursion to see the striking cavern which is located about 1¼ miles northeast of the village of Oxenden east of Wiarton. The cave entrance is formed in a cliff of dolomitic limestone about 50 feet in height. Two large chambers, one over a hundred feet in diameter, are connected by a small passage parallel to the cliff face at the rear of the rooms. Large slabs of broken rock, once forming part of the ceiling, now cover the floor and the large pillar at the entrance, together with the enormous size of the chambers, makes this cave attractive to many residents of the area.

The presence of numerous boulder beaches raised high above the lake level, along with the general nature of the cave itself, indicates that this and many of the smaller shelter caves in the region are remnants of wave erosion by a lake whose level was considerably higher than at present.

Numerous caves of the rock shelter type are found along what is known as Elora Gorge excavated by Irvine Creek where it joins the Grand River. The caves are most numerous in the west wall of the gorge. Rooms 10 to 20 feet in diameter and up to 10 feet high were at one time adorned with beautiful and delicate stalactites which are now represented only by small broken stubs and markings on the ceiling.

The porous nature of the rock at Elora is indicated by spectacular curtains of ice stalactites. At times during the winter months, sheets of delicate icicles up to 60 feet high are formed. In the caves themselves, water dripping continuously from the ceilings forms nearly transparent stalagmites of ice in bulbous and knobby shapes up to 2 feet high.

On the east bank of the Grand River immediately south of Elora, erosion of a shelter cave has formed a picturesque small natural bridge.

Large rock shelters occur in cliffs of dolomitic limestone along the south shore of Barrow Bay in the Bruce Peninsula. The largest shelter measures 110 feet long by 60

The natural bridge at Lion's Head.

feet wide and up to 25 feet in height. Small crawlways are found at the rear of the chambers and in some cases are choked with speleothems up to 7 inches in length. The large size of the caves together with the picturesqueness of the surrounding countryside where impressive white cliffs plunge into deep embayments of blue water, make this area very popular with naturalists.

Several small shelter caves have been formed in poorly consolidated Pleistocene gravels and conglomerates in the vicinity of west Hamilton. One cave, 15 by 4 feet in size yielded the first Pleistocene bird remains reported from Canada. One of these birds, a wood duck, is the first Pleistocene or Ice Age record of the species. The others, a barred owl, red winged blackbird and common grackle were previously discovered in Pleistocene or Ice Age beds in Florida.

"Sea caves" or caves and caverns resulting from the action of waves upon rocky shores have been formed by the enlargement of minute or incipient fractures in the rock by the hydraulic pressures set up by surging waves. Further enlargement is achieved by undercutting and piecemeal collapse of the ceilings. Sea caves are found at various places along South Bay in Lake Ontario and at Lion's Head in Georgian Bay.

Disappearing streams or swallets are not abundant in Ontario. Hepworth Creek disappears underground about one mile east of the village of Hepworth but the passages are not sufficiently large to permit human exploration. A few small disappearing streams are found in Keppel township and over a mile southeast of the village of Tara the Sauble River enters the ground and emerges some distance to the west.

The caverns of Ontario are small in size because the high magnesium content of the limestone tends to reduce considerably their solubility and because the limestone beds themselves lack the thickness to support caverns of any great extent. Nevertheless, several caves like those of Rockwood area and Hope Bay exhibit curious calcite deposits and various forms of cavern life, of interest to both the naturalist and the week-end explorer who may search out these beauty spots of southern Ontario.

Exploring sea caves at South Bay.

A highlight of the convention was the display of traditional Indian dances. John Kay, Poor Man's Reserve, leads the Prairie Grass Dance, followed by his son Joseph and other dancers. The head-dresses are made from dyed porcupine quills.

Saskatchewan Trappers' Convention

by CELIA WARBURTON

Photographs by the *Star-Phoenix* except where credited

SASKATCHEWAN's Trappers' Convention, probably the only one of its kind in the world, is now held annually in January at Prince Albert. Here, northern trappers meet with provincial and federal government officials to discuss, argue, and debate development of the oldest industry in the province — trapping.

Prince Albert, known as the "Gateway to Saskatchewan's North", and located in the north central part of the province, is a logical gathering place for this colourful convention. Situated on the edge of the province's last frontier, much of the northern road and air transport stems from this interesting, historic city of 25,000 people.

The three-day convention, which began tentatively eleven years ago, has since developed into an annual and unique event. Interest is now Dominion wide and many visitors from other provinces attend to see what Saskatchewan is doing to help her northern trappers — a problem common to many other areas in Canada.

Considerable excitement stirs the city the night before the convention gets underway. Trappers, accustomed to the long, lonely trapline, meet with old friends, wander about the city in moccasins and buckskin jackets, looking at the sights and generally enjoying themselves. Used to bedrolls and "boiling up" on the trail, they sleep between crisp, white sheets in the hotels and eat in the city's restaurants. Government personnel arrive by air and by car. Harold Read, Fur Administrator for the province, responsible for many of the arrangements, is cheerfully unperturbed as he manages to be in six places at once.

During the convention, the trappers and officials crowd in an extraordinary amount of business and fun. The business part of the convention is usually marked by some "straight talk" by both officials and trappers.

At least one evening is given over to a banquet and merry-making. The few tickets available to the outside public for this event are in great demand. These fun loving people participate with enthusiasm in competitions which include Indian love songs, moose and wolf calls, honking of wild geese and other lively forms of entertainment. Prizes, donated by the Saskatchewan Fur Marketing Service and the trappers themselves, are presented for fur and pelt preparation. Exhibits in the hall include Indian Handicraft, various types of humane traps, furs and new ideas pertaining to the industry.

The convention is part of a provincial government policy to get the trappers to par-

Joseph Kay performs the difficult Hoop Dance.

The Deputy Minister for Natural Resources, Saskatchewan, J. W. Churchman, gives the address of welcome to the convention. Allen Ahenekew, the Cree interpreter, stands at the left. Seated are, left to right: Harold Read, Fur Administrator; A. H. MacDonald, Director, Northern Affairs Branch, Saskatchewan Government; E. L. Payntor, Director of Wildlife; T. A. Harper, Assistant Director of Wildlife; W. G. Tunstead, Indian Affairs Branch.

ticipate in the formation of conservation and policy regulations for fur and wild life, believing that if the trappers themselves could see the reason for the regulations, they would support them. The idea was born out of necessity when a few years ago furs declined in quality and quantity to an extent where northern trappers were in dire trouble.

While there is an easy informality generally between government "officials" and the trappers, the convention itself is conducted with considerable formality and pretty much geared to the Indian way of doing things. Discussions are long and points debated lengthily. In the smoke filled air of the convention room, heavy with the odor of moose and caribou hide, about ninety trappers argue recommendations, first in small panel groups, and later on the floor. Through it all, the sonorous tones of Allen Ahenekew, the Cree interpreter, is heard.

All resolutions brought in by the delegates

Trappers wives attending the convention give close attention to the proceedings. Left to right: Mrs. Sophia Moostoos, Hudson Bay; Mrs. Norman Fraser, Shell Lake; Mrs. Peter Mazurau, north of Meadow Lake.

Two trappers, Thomas Sewat of Pellican Narrows and Noah Valentine of Deschambeault, speak their minds at the convention. Saskatchewan Govt. photo

are carefully discussed and voted upon by the convention. If passed they are taken into consideration by the Fur Advisory Committee. When feasible, necessary action is taken to put them into effect.

Trapping in the northern part of the province is now carried on under the Northern Conservation Program which consists of 98 conservation areas and 3,500 trappers. The Conservation areas are formed by a number of the trappers in a community who meet periodically with a conservation officer to plan local conservation methods for their area.

Delegates to the convention are drawn from these areas and to date about 80 per cent of them have sent representatives. The delegates take resolutions from their groups to the convention. Their traveling expenses in the past were paid for out of block funds set aside for that purpose and made up in various ways. In some cases, the fund is composed of a stated number of pelts donated by each trapper.

The men exhibit the rapt attention of the delegates. From left to right: Billy Shot, Uranium City; Ernest Isbister, Lac la Ronge; and Joe Whitehead, Shoal Lake.

Mary McDonald of Fond du Lac exhibits leather craft made from patterns and bead designs learned from her mother and grandmother. She hopes to develop this industry more fully to provide work for the Indian women of her area. Saskatchewan Govt. photo

This year, federal and provincial assistance was forthcoming to trappers who had to travel long distances by air and whose areas could not finance the air fare. Some delegates travel as far as six hundred miles.

The areas are a form of self-government. While overall trapping and hunting seasons are set by the provincial government, the trappers, working with the wildlife officer, recommend their own limits and seasons. In this way, the areas are able to protect their scarce animals and trap fully the plentiful fur.

Vacant trapping ground within the northern conservation areas is now scarce and to obtain a license an applicant must have lived in the area a year and be accepted by the trappers before the application can go before the Fur Advisory Committee, consisting of federal and provincial wildlife officials.

To assist the trappers in the sale of their fur, the provincial government set up a Fur Marketing Service prior to the commencement of the program. For several years all beaver and muskrat pelts were sold through this service, but it did not prove too popular with a number of the trappers for several reasons. The compulsory aspect of the program was resented by many, and also trappers, accustomed to living on credit from the local stores, had to sell their furs there to pay their debts. Nor did the trapper like to wait for his final payment until the furs were sold at public auction.

The service is much more popular since the compulsory aspects were removed at the request of the trappers and a larger initial payment is issued when the furs are accepted. There are signs, too, that the trapper, accustomed to evaluating his place in the community to the extent of credit allowed him, is beginning to learn the value of cash in hand.

Approximately 80 per cent of Saskatchewan's northern trappers are Metis and Indian. Due to social services instituted by the government, this population has increased rapidly and authorities recognize that both the fishing and trapping industry must be developed since they are at this time one of the main forms of revenue for these people.

Efforts to help the native trapper to help himself have resulted in some interesting experiments in the north. One under way now

The youngest and prettiest Indian attending the convention was five-year-old Betsy Rose Masuskapew, from White Fish Lake.

at Montreal Lake was started by the trappers themselves. To prevent trappers from spending money unwisely when bringing in large amounts of fur, they voted unanimously to begin a trust fund consisting of 10 per cent held back from their fur sales. This money is kept until the following fall to be used for traps and other needs. Directors decide when the money should be withdrawn.

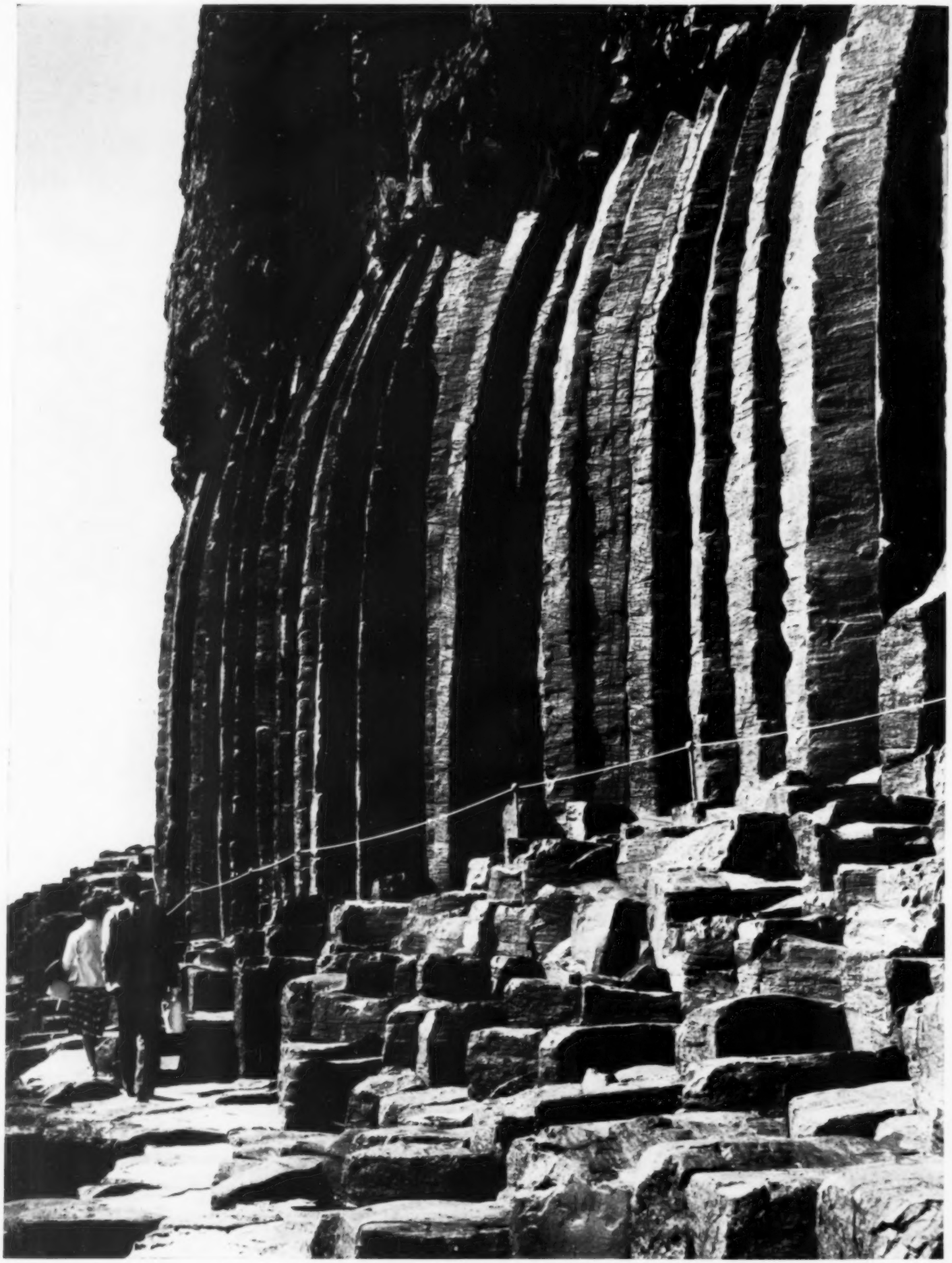
Trapping would seem to be pushing its way back into a position of importance in the economy of the northern people. The beneficial effects of the conventions are shown in some of the sales figures. During the first year of the program, during 1946-47, beaver pelts taken were valued at $40,970. During the 1956-57 season some 26,972 beaver were harvested at a value of $219,072. In 1959 trappers took over fifty thousand mink valued at close to a million dollars and fifty thousand beaver amounting to over half a million dollars. The annual revenue derived from Saskatchewan wild fur during the past ten years is around 2½ million dollars annually.

Saskatchewan fur has in recent years received some recognition for its quality and trappers are showing an increased awareness of the need to improve and maintain this prestige. Trapper Bill Cheney, Chairman of the 1960 Convention, pointed out there is a need to bring new ideas and approaches into the trapping industry.

Trapping, he noted, is the only industry in the province which still uses the same tools and methods of a hundred years ago.

While trapping will probably always be a tough, rugged occupation, with the advice of government personnel and self-help, the coming years must surely result in a new era for the northern trapper and Saskatchewan's wild fur will attain a position of importance on the world fur market.

The Indian Boy Scout Troop from Gordon's Indian Residential School at Gordon's Reserve near Punnichy, demonstrate precision marching and games led by Gordon Head, grade nine student. These boys, mostly sons of trappers, come from all parts of Saskatchewan and a few from Manitoba.



A close-up view of the basaltic colonnades of Staffa Island. The stubs of broken columns form walkways along the base of the cliffs.

Colonnaded Staffa Island

by LYN HARRINGTON

Photographs by Richard Harrington

A REMARKABLE island off the west coast of Scotland, without a single inhabitant, has drawn poets, musicians, and of course, geologists, like a magnet. Staffa's 71 acres of amazing basaltic colonnades lie seven miles west of the Isle of Mull in the Inner Hebrides.

Staffa gets its name from these weird columns which rise to a height of sixty feet and more. The name is derived from the Scandinavian, and means "pillar island". The Norse sea rovers knew it well.

Geologists claim that Staffa was once part of the Isle of Mull, and was created as a separate island by centuries of volcanic activity. Erosion by the sea and heaving of the earth's crust separated Staffa from its parent by miles of water. Conglomerate tufa forms the base of the steep-sided island. Columnar basalt arranged by nature in colonnades is the middle layer, with amorphous basalt overlying the whole.

The Isle of Iona, five miles south, is totally different in its rock formation, while Ulva to the east has basalt formations as spectacular as those of Staffa. Some geologists suggest that the same basaltic formation runs all the way under the Atlantic to crop up as the Giant's Causeway in Northern Ireland.

The sea has carved good-sized caves in the volcanic rock. Clam-shell Cave is so named because the columns forming it were bent in an arc. McKinnon's and Cormorant Caves are noted for their thousands of wheeling seabirds; but Fingal's Cave is the chief attraction.

Vacationists on the Isle of Iona can choose any quiet day for landing on Staffa by small boat. Cruise passengers can disembark only when the sea is "dead calm". Even a small swell makes it too dangerous to attempt to land 600 passengers in small boats and take them off again half an hour later.

During the war years, a German mine was washed up on Staffa and exploded, blowing down many basaltic columns and ruining the tiny landing dock. For over ten years, no cruise passengers could be landed at Staffa.

This popular cruise around the Isle of Mull

A boatload of passengers from the cruise-ship arrives at the landing dock on Staffa Island, where other passengers are ready for the return trip.

(Upper right)—The entrance to Fingal's Cave. Like giant steps, the broken colonnades lead from the water's edge up into the cave.

(Upper left)—The interior of Fingal's Cave seems to have been chiselled out by some giant craftsman. Visitors may go about halfway into the cave on foot.

(Left)—View from inside the cave looking out to sea on a calm day.

takes a full day, and is a sea voyage in miniature through impressive scenery. Our day began at Oban on the Scottish mainland, and our ship made a brief call at Tobermory on the Isle of Mull. Tobermory Bay is famous for many efforts to recover a treasure of gold believed to be on a sunken Spanish galleon on the ocean floor. After visiting Staffa and Fingal's Cave, we went to Iona, where we wandered up the Street of the Dead, among the ancient ruins of St. Columba's monastery, and through the restored cathedral.

After weeks of Atlantic gales, the sea was quiet enough to permit a landing on Staffa Island, the achievement of the day. The little pier has been replaced, and it is only a quarter-mile walk along the base of the cliffs to Fingal's Cave. "The Causeway" leads over the smoothed tops of those broken colonnades, with concrete between the hexagonal stubs. In fact, there are two walkways, one for passengers going to the cave and an upper path for those returning to the pier.

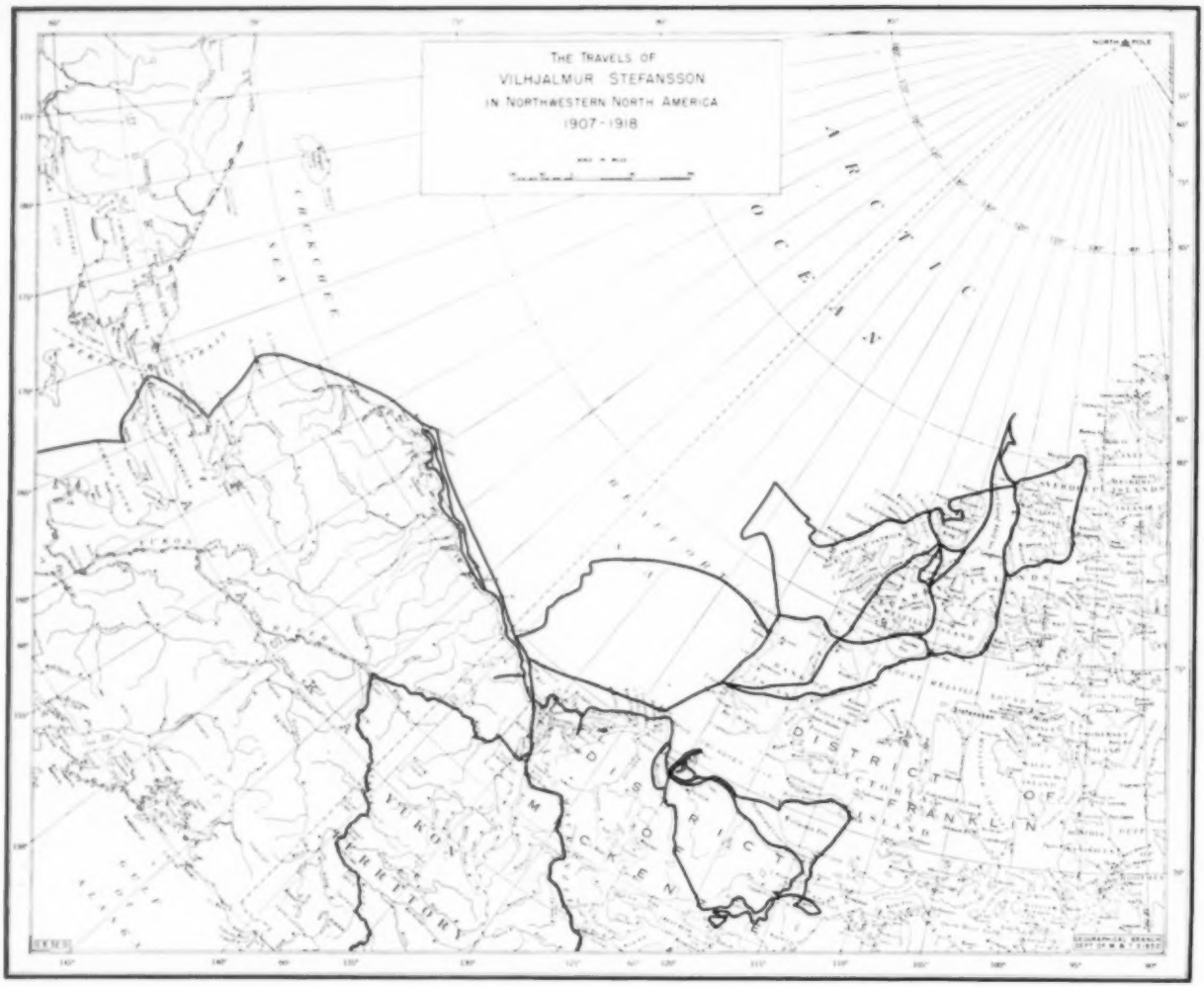
A roped walkway leads about halfway into the depths of Fingal's Cave, which is 42 feet wide, 66 feet high, and 227 feet deep. The surf rushes in, crashes against the wall at the back, and retreats sucking broken rock with it. The basaltic rock of the walls and roof seem to have been chiselled by a master mason.

Fingal's Cave has had many distinguished visitors, but Felix Mendelssohn, after his visit in 1839, made its name known around the world by his magnificent overture.

Staffa's treeless acres are uninhabited except by seabirds. When Sir Joseph Banks, the great botanist, visited here in 1772, he found a solitary hut tenanted by a peasant who looked after some cattle. The herder supplied Banks' party fish and milk, and was so delighted to have company that he sang Gaelic songs all night. Twelve years later, the celebrated French geologist Faujas de Saint Font visited Staffa at the peak of its population — sixteen. Two families lived in indescribable squalor in two stone huts.

Not even sheep graze on Staffa's windy terrain now. Fingal's Cave opens to the west with nothing but the wild Atlantic waves between it and Canada.

Staffa Island viewed from the sea.
The small boat landing is to the right, and Fingal's Cave is around the corner to the left.



Vilhjalmur Stefansson

by D. M. LeBOURDAIS

FOR HALF a century, Vilhjalmur Stefansson, now eighty years of age, has been the outstanding exponent of the significance, not only for Canada but for the world, of the Far North. Except for two short periods when he was organizing further expeditions, his whole time between 1906 and 1918 was spent gaining valuable knowledge of Eskimo life and exploring the practically unknown northern regions of Canada.

He was the organizer and commander of the Canadian Arctic Expedition, 1913-1918, which in many ways was the most important ever to explore the Arctic. His account of that expedition, *The Friendly Arctic*, published in 1921, has become an Arctic classic. In 1915 and 1916, he discovered islands in the Parry Group (now known as the Queen Elizabeth Islands), with an area of approximately 4,358 square miles, marking the final phase of an era that had begun with Frobisher, Davis and Baffin. This rounding-out of Canada's areal limits was an event of historical import, yet (except for an R.C.M.P. patrol in 1929), no Canadian was to set foot on any of these islands until 1958, when Raymond Thorsteinsson and E. T. Tozer of the Geological Survey of Canada carried out a reconnaissance survey and found that they form part of a sedimentary basin having excellent oil

and gas possibilities.

Although Stefansson was born in Canada (Gimli, Manitoba, November 3, 1879), a circumstance of which he has always been proud, his becoming an Arctic explorer was an accident. In the course of post-graduate work at Harvard he had been preparing to join a British anthropological expedition in Africa when he was offered the post of ethnologist on an expedition which proposed to operate in the Canadian North.

While at Herschel Island waiting for the expedition's ship to arrive, he was told by sailors from a whaler of Eskimos they had seen in Victoria Island who resembled people of European ancestry. The possibility that these strange people might be descendants of the "lost" Norse colonists of Greenland fired his desire to see them at first hand.

The ship was wrecked and Stefansson found himself footloose on the Arctic coast. With little money and no knowledge of the ways of the country, he decided to learn how to become self-supporting by living with Eskimos and, as nearly as possible, becoming one of them. During the winter of 1906-1907, he was a member of two successive Eskimo households.

Young and inexperienced when he arrived, his head was filled with the myths upon which the popular view of the Arctic is based; but approaching it as an anthropologist, he soon saw that a land in which children are born and live happy lives through to old age cannot be the terrible place of popular imagination. His success in the Arctic is not due as many believe to exceptional endurance, but to his intelligence.

By spring the Arctic had already claimed Stefansson for its own and the desire to visit the people who resembled Europeans had become a fixation with him. In order to do so he must organize his own expedition, and this took him to New York where he quickly gained the backing of the American Museum of Natural History. He proposed to go alone to the Arctic, living mainly "off the country", and especially to spend some time with the Eskimos in the vicinity of Victoria Island. A University of Iowa classmate, R. M. Anderson, a naturalist, wrote suggesting that without greatly increasing the cost two could secure much more information than one, and asked if he might join the expedition. Stefansson agreed and had no difficulty in securing the Museum's consent.

Owing to various delays, it was not until the spring of 1910 that Stefansson came into contact with people (at Cape Bexley) who had never seen white men, and a few days later, on the south shore of Victoria Island, he encountered the first of the Eskimos he had most wished to meet. His impression of that event is given in *My Life With the Eskimo* (1913):

> When I saw before me these men who looked like Europeans in spite of their garb of furs, I knew that I had come upon either the last chapter and solution of one of the historical tragedies of the past, or else that we had here a new

Stefansson, photographed by Wilkins (later Sir Hubert), Banks Island, autumn of 1914.
Canadian Geological Survey

> mystery for the future to solve: the mystery of why these men looked so much more European-like than other Eskimos if they are not of European descent.

In the fall of 1912, the expedition returned to the United States, and Stefansson was front-page news; magazines requested articles and he was in demand as a lecturer. The discovery of the "Blond Eskimos," as an imaginative reporter dubbed them, greatly overshadowed in public interest the other accomplishments of the expedition.

In spite of his many activities, Stefansson was promoting a new expedition — one that would differ from any of its predecessors. At that time the Arctic Ocean, except in the vicinity of land, was considered by everyone — sailors, explorers and scientists alike — as devoid of life. Eskimos hunted seals close inshore and never ventured any great distance from land; for they, too, did not believe that life existed in the depths of the sea.

Stefansson knew that life was prolific in Arctic waters, and that wherever plankton existed seals would also be found and could be secured by following Eskimo methods — which would work just as well over deep water as near shore. To test this theory and to conduct geographical exploration and scientific research were the chief objectives of the new expedition.

The National Geographic Society and the American Museum of Natural History each subscribed $22,500, but more was needed. He had received Canadian support for the previous expedition and he thought Canada might be interested in this one too. He therefore went to Ottawa and found that Sir Robert Borden, the Prime Minister, was eager to have his government assume the entire responsibility — if the American sponsors would withdraw. This was easily arranged, and in April, 1913, the Canadian Arctic Expedition, Vilhjalmur Stefansson commanding, came into being.

The expedition was divided into two sections, a northern one under Stefansson's direct command, to conduct exploration and scientific investigation in the Beaufort Sea; and a southern section which would conduct surveys and research along the Arctic coast of Canada and in adjacent areas. Before the transfer, Stefansson had offered the post of second-in-command to Anderson, who had accepted. After Canada took over, personnel for the southern section was recruited largely from the staff of the Geological Survey of Canada, of which Anderson had become a member.

As the main ship of the expedition, Stefansson selected the whaler *Karluk*, familiar to him in previous years. As her skipper, he chose Captain C. T. Pedersen, also well-known to him. Pedersen resigned because he feared that he might be required to renounce his U.S. citizenship if he took command of a Canadian government ship. Stefansson then appointed Captain "Bob" Bartlett, for many years Admiral Peary's sailing-master. This change in captains was to have tragic consequences.

The *Karluk*, after outfitting at Esquimalt, B.C., went on to Nome, Alaska, to complete its loading and was joined there by two smaller vessels acquired for the southern section; and late in July (1913) the three ships, heavily laden, sailed northward, but storms and drifting ice soon separated them and they never got together again.

Steaming up the Alaskan coast, Stefansson explained to Bartlett the difference between the sailing-practices there and those in Atlantic waters where the farther from shore a ship can sail the looser the ice becomes, while the reverse is the case in Alaska. Generally it was possible to keep to narrow lanes of shallow water between the grounded floes and the shore. In some places, protected "lagoons" were formed by reefs and islands. Bartlett pooh-poohed such caution, suggesting that Alaskan skippers were a timid lot. Proceeding thus, the *Karluk* had reached Cross Island, where her progress was halted by ice ahead. In such circumstances the usual procedure was to wait patiently for an offshore wind.

The ship was at anchor when Stefansson went below to sleep, but he was awakened by the bumping of ice against the hull and realized that she was in the pack, "working ice." He admitted later that he should have ordered Bartlett to take her back inshore, but did not have the moral courage to do so.

Increasing pressure eventually brought her to a standstill, and she never moved again under her own power. "This was my most serious error of the whole expedition," he wrote in *The Friendly Arctic.*

The *Karluk* drifted with the pack until about the middle of September when she came to rest in Harrison Bay where she might, with luck, have remained frozen in for the winter. Stefansson now selected a few men to go ashore with him to hunt caribou for meat and skins.

Shortly after they had set off, a storm carried the ship, still locked in the floes, out of their sight. Stefansson was not to know her fate for seventeen months, when he learned that after drifting a thousand miles she had been sunk (in January, 1914) about sixty miles northeast of Wrangel Island, off the Siberian coast.

With a less resolute and resourceful commander, the *Karluk's* loss might have been a fatal blow, but Stefansson soon had evolved new plans from the wreck of the old. The largest unexplored area in the Arctic at that time was the Beaufort Sea; it was the most likely spot in which to look for new land, and Stefansson's hopes of achieving something of value were centred in it. His plan was to travel northward over the ice with two companions, continuing as far as travelling conditions would permit, and returning by a diagonal route, either east or west of his starting point. Preferably, depending upon circumstances, a landing might be made on either Banks or Prince Patrick Islands, in which case a base would be established for further exploration the next year.

The historic exploratory journey began at Martin Point, Alaska, on March 22, 1914, when Stefansson, Storker Storkerson and Ole Andreasen, set off across the Arctic ice. They had one sledge and six dogs with a load of 1,100 pounds, including food for a month. When snow was suitable, they would sleep in snow-houses, otherwise in a tent. An important part of the equipment was Stefansson's Gibbs-Mannlicher-Schoenhauer rifle with 170 rounds of ammunition and a 30-30 Winchester carbine with 160 rounds.

As Stefansson had expected, the going for a considerable distance from shore was most difficult. Near shore the pressure causes the pack to buckle into huge ridges through which it was often necessary to chop their way. At other times, delays were caused by open water, but sooner or later the leads would freeze over and allow them to proceed.

Later, when advancing spring resulted in wider leads which did not freeze, or insuffi-

Members of the Canadian Arctic Expedition at Collinson Point, winter of 1913-14. Left to right: John R. Cox, Kenneth G. Chipman, V. Stefansson, Daniel W. Blue.

Canadian Geological Survey

Stefansson and his wife at Dartmouth College, reading congratulatory messages on his eightieth birthday.
David Batchelder

ciently to bear a load, they crossed from one icefield to another by means of a "sledboat." This contraption was built thus: a tarpaulin was spread on the ice and the 14-foot sledge placed upon it; two sticks, six feet long, carried for the purpose, were lashed crosswise, a framework being completed by lashing a ski on each side. The edges of the tarpaulin were then brought up and secured to the framework. This provided a boat capable of carrying 1,000 pounds.

Since they started with approximately thirty days' food, no time was spent during the first month in hunting seals, but toward the end of April Stefansson realized that the testing-time had come. The first seal was seen on May 7, but not till a week later were they able to shoot one that did not sink. Contrary to the general view that seals would not be found in water deeper than 1,000 feet, a sounding made at the first kill failed to find bottom at 4,000 feet.

Their course from Martin Point had been almost due north, but on May 25 they set a northeasterly course for Banks Island. Daylight was now continuous; the ice was covered with thaw water; and although they travelled mostly at night, the going was extremely unpleasant.

Land was sighted on June 22, but because of the large extent of open water and the erratic ice-drift, the date of their actual landing was the 25th, ninety-six days out from the Alaskan coast. They had settled the question of whether mammalian life sufficient to maintain a small party of skilled hunters exists in the Arctic seas; they had determined the continental shelf off Alaska and Banks Island and subsequently, certain of the Parry Islands; and they had carried a line of soundings through four degrees of latitude and nineteen of longitude.

The summer was spent in Banks Island, where they lived literally on the "fat of the land." Caribou were plentiful and large quantities of meat were accumulated against the coming winter. Before leaving Martin Point, Stefansson had bought a small schooner and had instructed George Wilkins, with the expedition as official photographer, to bring her to Banks Island in the late summer, when ice conditions would permit. Wilkins duly arrived, and Stefansson then learned that members of the southern section — and all the rest of the world — had already given him up for dead. With few exceptions, everyone along the coast was convinced that when the ice-party had eaten their thirty days' rations they would either return to Alaska or starve; and when they failed to show up it was assumed that they were dead. As a gesture toward a dead commander, Wilkins had kept the appointment.

The winter of 1914-1915 was spent at the Cape Kellett base, at the southwestern angle of Banks Island. In the spring, Stefansson, his two companions of the previous year and a newcomer who had come with Wilkins, travelled northward along the west coast of Banks Island until early in April, near the point of the previous landfall, they began an exploratory journey northwesterly over the ice of Beaufort Sea. Because the ice-drift was opposite to the direction of their course, poor time was made, and on May 6 they turned toward the southwestern corner of Prince Patrick Island. Travelling northward along the west shore of this island, they continued into an unexplored region to the north of it, and there they discovered new land (Brock Island) on June 18. A day or two later, they learned that beyond this discovery lay a much larger extent of new land, which was later called Borden Island. Not till the region was

mapped from the air was it learned that what had been taken for an island was actually two. The southern portion was named Mackenzie King, while the northern portion retained the name given to it by Stefansson.

In the spring of 1916, Stefansson and two others went to look over the newly-discovered land, and continuing northward discovered (June 15) another tract of new land, later called Meighen Island. On their way south they came on further new land, which was called Lougheed Island.

Stefansson had high hopes for the season of 1917, but he was disappointed. When he had reached latitude 80° 26′, his men (who had ignored dietetic warnings) were found to have scurvy and he was compelled to beat a retreat to the nearest land (Ellef Ringnes) where on a diet of caribou meat, much of it partly raw, they were cured. All hope of further exploration was abandoned for the season, which Stefansson ruefully realized must be the last that could be devoted to such a purpose. (The southern section had gone out in 1916).

Stefansson reached the outside world just before the Armistice of 1918, knowing that his days as an Arctic explorer were probably ended. He was aware that with the advent of the aeroplane and the submarine the era of the dog-and-sledge explorer was over. He took a keen interest in the career of his friend George (Sir Hubert) Wilkins, who, at the time of his death, was recognized as the foremost polar explorer.

As he saw it, his future field of activity lay in educating the public to the significance of the Arctic in world affairs. His immediate task was the completion of the expedition's report, which ultimately ran to eleven volumes. The greater part was written by others, of course, but his share was considerable. He was also at work on *The Friendly Arctic*, which is unique in the annals of Arctic exploration in that it introduces a philosophy of world geography without which the modern world cannot properly be understood.

In 1922, he published *The Northward Course of Empire*, in a sense a postscript to *The Friendly Arctic*, in which he predicted that Canada would be developed from south to north, even to the islands of the Arctic Ocean. He foretold a time when the great trans-polar air routes — and the submarines — would convert the Arctic into the crossroads of the world.

The various geographical societies were quick to recognize his services to science by conferring upon him their highest awards. Leading universities have done likewise with their honours. The formal thanks of the Government of Canada was expressed in a Minute of Council and of the people of Canada by a resolution of parliament.

He is the author of twenty-six books, all but one devoted to some aspect of Arctic life, and his articles for scientific and other journals number about four hundred. His library, now at Dartmouth College, was at the time of its transference the largest private Arctic library in the world. With headquarters in New York during most of the time since his return from the North, and latterly at Dartmouth, where he is Consultant to the Program of Northern Studies, Stefansson has been the unofficial Ambassador of the North.

Leffingwell Crags, Mackenzie King Island.

R. Thorsteinsson and E. T. Tozer

The 100-ton schooner, Chrissie C. Thomey, *left, was the first hydrographic survey vessel sent to commence the charting of the eastern Arctic in 1910. The auxiliary schooner* Burleigh, *right, was the first ship to be fitted specially for magnetometric surveys in northern waters. These ships were photographed in Hudson Strait, July 1910, by R. J. Fraser, a hydrographer of the 1910 survey expedition.* R. J. Fraser

Hydrography in Canada

by STEPHEN R. TITUS

Photographs by the Canadian Hydrographic Service except where credited

HYDROGRAPHIC work does not ordinarily come to public attention, but it is of great concern to those interested in Canadian mercantile development, and vital to all those who wrest their living from the sea. It has for its object the measurement and description of seas, lakes, rivers and other waters with special reference to their use for navigation and commerce. It charts the underwater contours from surface level down to the greatest depths; it shows the shape and position of the adjacent shores and the location of the outlying rocks and shoals; it indicates the natural landmarks which can serve as aids to the navigator; and it is concerned with the observation of the tides and currents.

This complex and exacting science of hydrography has made a major contribution towards Canada's development. As far back as late in the fifteenth and early in the sixteenth centuries explorers were searching out new water routes around our shores, always on the alert for safer channels and better harbours for the adventurous shipping which was beginning to cross the Atlantic. The use of the sea from early times as a highway of communication and transport made it advantageous for nations to supply their vessels with navigational information regarding their coasts and waters; thus, hydrographic establishments grew up in all Maritime countries. Now, the Canadian Hydrographic Service takes its place among the leading organizations in this field.

The name of the first navigator to chart any part of the Canadian shores is unknown, but on one of the world maps produced in

Spain in the first years of the sixteenth century, the coastline in the vicinity of the Strait of Belle Isle was already recognizably recorded. The first period for which we have any continuous historical record of charting begins with the voyages of Jacques Cartier in the 1530's and continues until the end of the French regime in the middle of the eighteenth century. During this period coasts, harbours, and many inland water routes were charted by French mariners and explorers, or by hydrographers officially appointed for the purpose by the Government of France.

With the transfer of the colony to Britain in 1763, these responsibilities fell to the British Admiralty, and among the names of outstanding hydrographers who worked on the Canadian coasts in this early period are those of Captain Cook and Captain George Vancouver. After the War of 1812, the need for a hydrographic survey of the Great Lakes was recognized, and officers of the Royal Navy began the work. Most famous among those who surveyed the Lakes at this time were Captain W. F. W. Owen and Admiral Bayfield. Then, in the latter part of the nineteenth century, the increasing number of larger and swifter vessels on the Great Lakes made a new survey necessary, and in 1883, less than 20 years after Confederation, the Canadian Government undertook this responsibility. As Canada at that time had no qualified hydrographers, the Admiralty loaned Captain J. G. Boulton, one of its experienced surveying officers, to organize and begin the survey and to train qualified Canadian engineers in the exacting requirements of this work. One of these Canadians, William J. Stewart, succeeded Captain Boulton as officer-in-charge of the Survey in 1893.

Although Canada had taken over the work of hydrographic surveys of her inland waters, it was not until 1904 that she was finally to accept, in principle, the heavier responsibility for all charting along her extensive sea coasts, and not until 1910 that she was to have the ships and personnel necessary for this task. Today, almost all charting operations, both for Government projects and for private enterprise, are undertaken by the Canadian Hydrographic Service.

This is a truly enormous task, for Canada's tidal coastline is among the longest of any country in the world, extending for more than 100,000 nautical miles and bordering on three oceans. As most dangers to shipping lie in the relatively shallow waters of the continental shelf, it is in this area that hydrographic charting is most needed. The continental shelf extends offshore approximately to the 100-

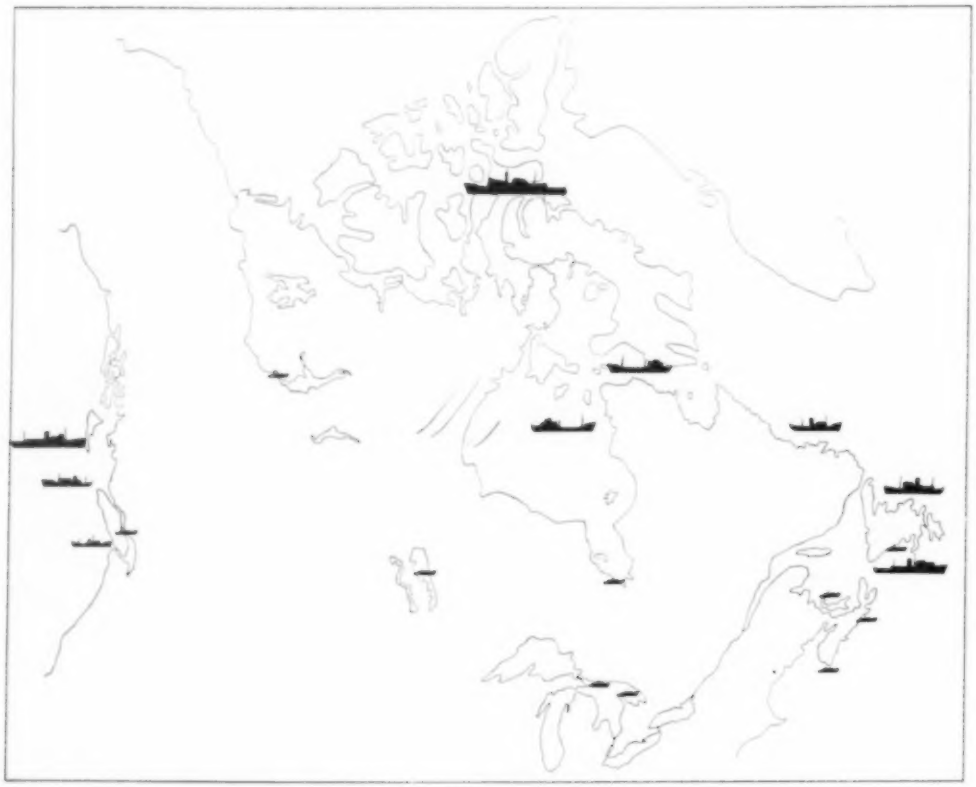
Meeting the challenge of the North is the newest addition to the hydrographic fleet, C.G.S. Baffin *(see "Canada's Northern Queen" by John P. Ough, in the* Canadian Geographical Journal, *December, 1959). Built for work in the Arctic, the ship is equipped with the most modern hydrographic and navigational instruments.*

fathom limit and its width varies from place to place depending on the gradient of the bottom. On the Pacific, the shelf is usually narrow with its edge often located somewhere between two and fifteen miles offshore. Along the Atlantic, where the gradient is more gentle, it may stretch seaward for 130 miles or more. In the North, it extends far from the mainland into the Beaufort Sea and the Arctic Ocean and includes the channels separating the islands of the Archipelago. With such an extensive coastline it is inevitable that, regardless of variations in width, the size of the continental shelf surrounding Canada will be very considerable. It has, in fact, been estimated as equal to 42 per cent of her land area. The edge of the shelf, however, is by no means the present-day limit of Canada's hydrographic surveys; the deeper channels and the waters beyond the shelf are also charted, often to depths of several hundred fathoms.

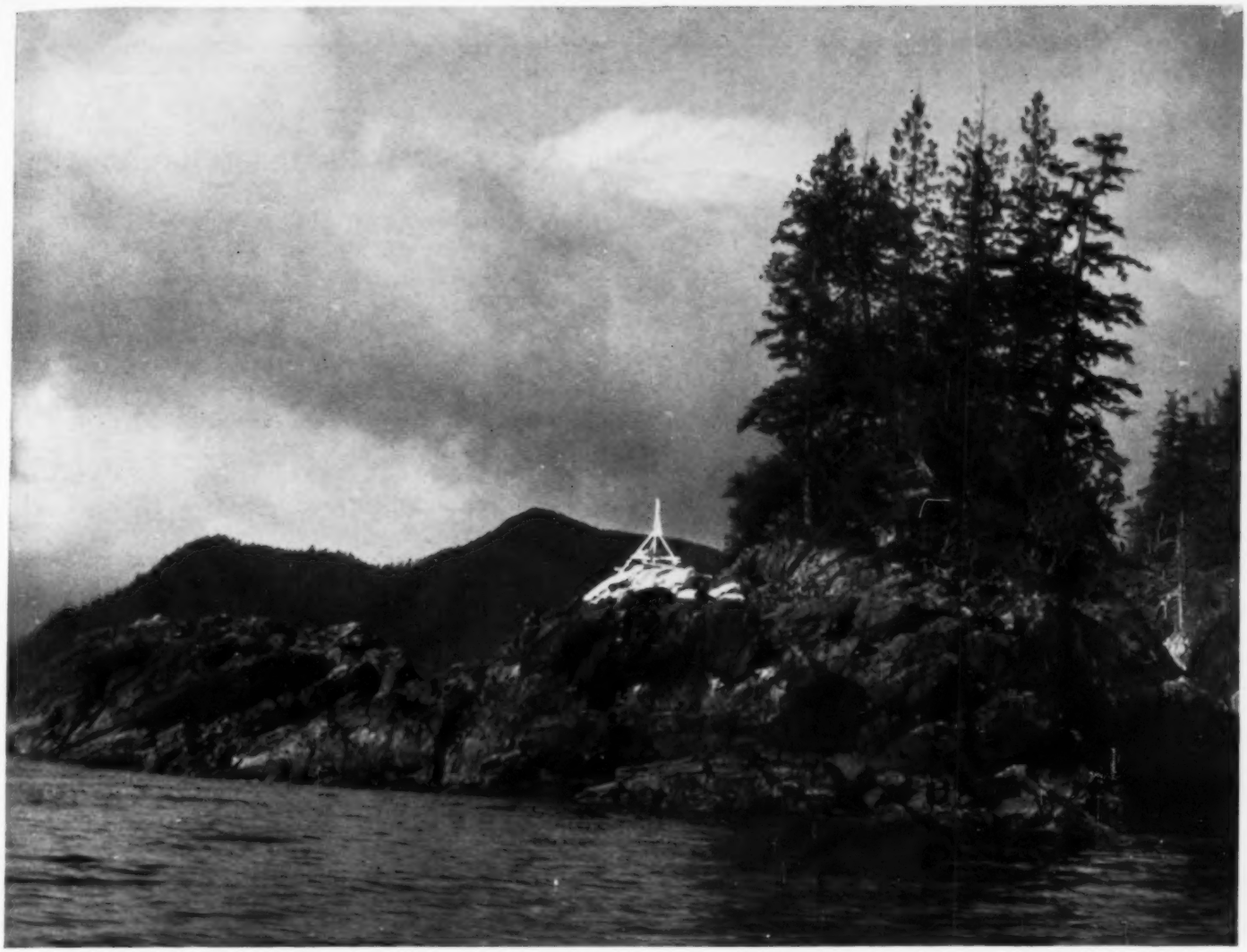
In addition to its work in the coastal waters, the Canadian Hydrographic Service is responsible for the charting of thousands of miles of inland waters. Field parties are at work every year checking and collecting the data needed for the production and revision of the charts of Lake Winnipeg, Great Slave Lake and the Mackenzie River, as well as those of the great freshwater seaway which stretches from Quebec to Fort William and Port Arthur.

The demands for new navigational information and for special surveys, together with the maintenance of long-term charting plans, put a heavy strain on the resources of equipment and personnel which this Service has at its disposal. At present, the average annual coverage for each ship is about 2,000 square miles of sounding per season. Thus, for example, it would take one ship more than 100 seasons to chart the whole of Hudson Bay. As the charting area is advanced northward, the rate of progress is naturally slower, both because of the ice conditions, which decrease the manoeuvrability of the vessel, and also because of the shortness of the navigation season.

The task of charting is becoming less laborious than it was a quarter of a century ago; the hand lead-line has been replaced by the echo sounder; electronic instruments have made possible accurate position-fixing many miles at sea; and the sextant may one day be laid aside and microwave positioning for inshore sounding take its place. Other aids to the hydrographer are the tellurometer for



Distribution of hydrographic survey ships and launches in Canada.

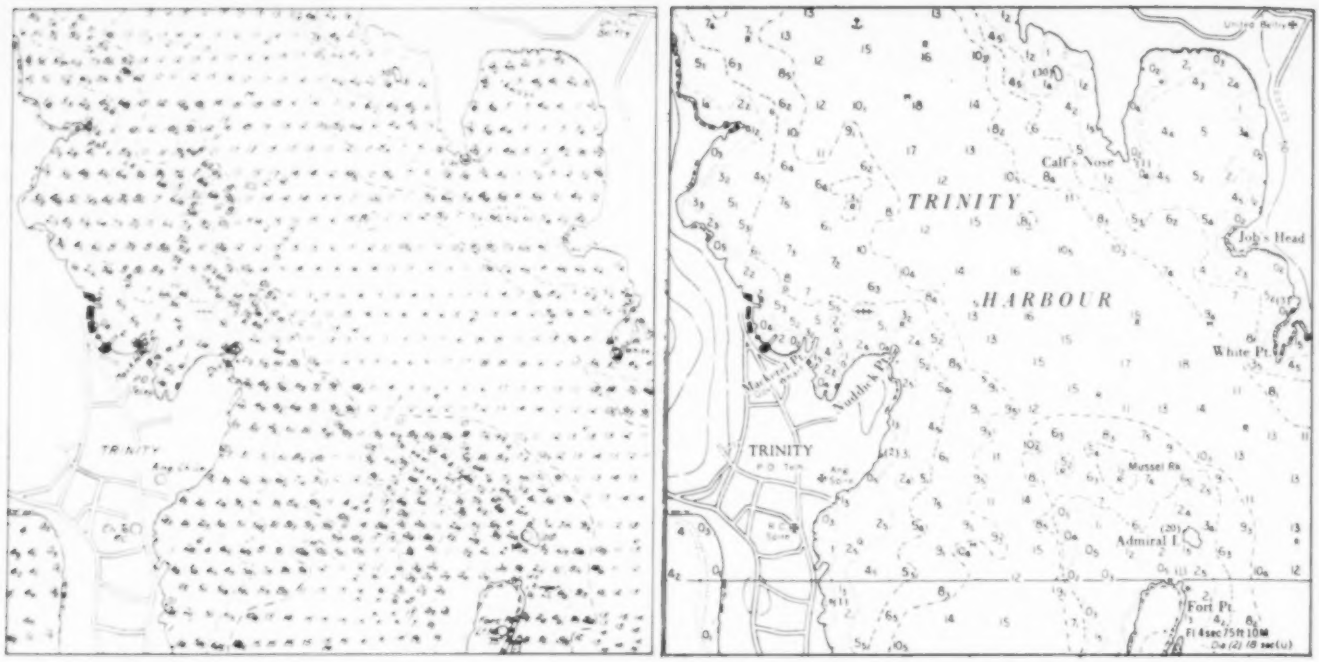


A typical hydrographic survey beacon. Beacons such as this erected along the coastline and on offshore islands aid the hydrographer in positioning himself when carrying out inshore sounding.

measuring horizontal distances ashore and modern aerial photographs which make possible the rapid delineation of the shoreline. We are told of new navigational devices which will revolutionize the ancient art of sea navigation. Even the ships themselves are being constructed for greater endurance and longer cruising ranges. Nuclear power may, within the foreseeable future, be used to assist the hydrographer in operating his vessel for still longer periods, and to greater distances, through turbulent waters and heavy ice. Perhaps the use of under-ice craft will be the next development in the charting of our northern regions.

Starting off early each spring from the Regional Offices at Halifax and Victoria, and from the Ottawa headquarters, some 100 hydrographers join the Service's nine ships and fourteen surveying launch parties in their quest for nautical information which, when compiled and incorporated in charts, will serve Canada's growing requirement for hydrographic data.

These hydrographic ships and launches are especially designed, or refitted, for the work and are manned by more than 400 officers and crew members, each of whom plays an important part in the carrying out of the carefully laid plans which take them many miles from their home bases. They have with them the most modern instruments and equipment including electronic sounders which, measuring the depths exactly and precisely at a rate of up to 200 times per minute, give a continuous profile of the ocean floor. They have gyroscopic compasses, radar for navigation in fog and darkness, radio telephones for communication between the ship and her auxiliary units, and one of the most modern positioning instruments, namely two-range Decca, which shows accurately the position of the ship in relation to two previously located shore stations.



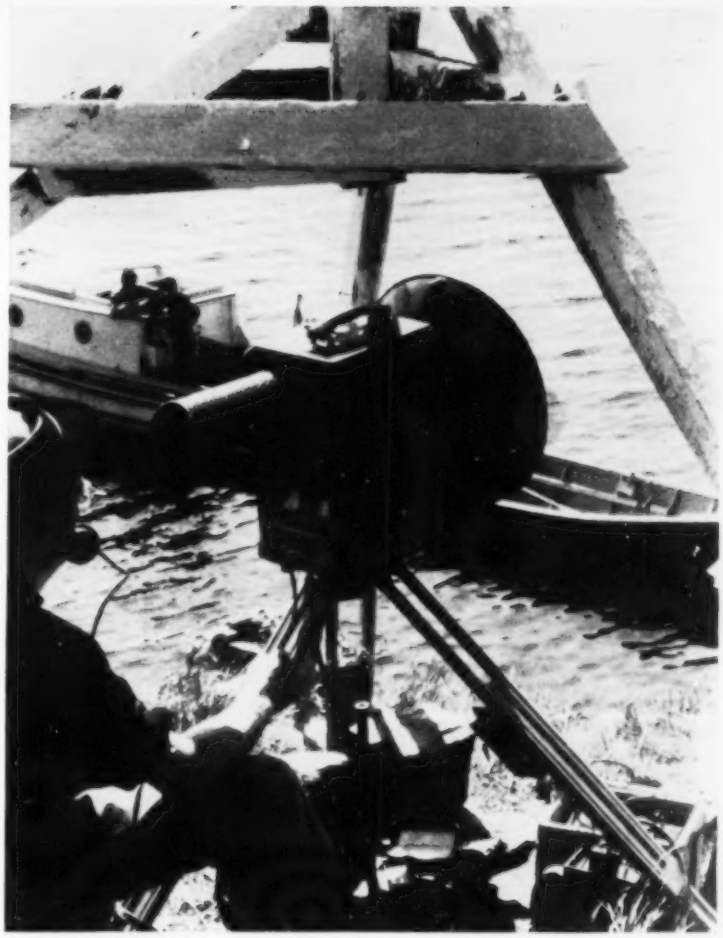
Trinity Harbour, Newfoundland, showing a portion of the field sheet, left, and the finished chart, right.

Once in the area, the hydrographers can, with these aids, readily determine their position and the ship can then be directed on previously designated courses. When the charting area has been covered, the results are processed from the echo sounder and are inked-in on the field sheet. Contours of the ocean floor, based on the soundings, can now be drawn and extensive investigations made of critical depths, of reefs, channels and harbours, clearing ranges and other features which will aid the mariner in navigating his vessel on a safe course.

Among the outstanding contributions of our hydrographers in the last 30 years is the positioning of Superior Shoal in Lake Superior which, prior to that time, was believed to have taken a heavy toll in lives and shipping. The discovery of Gray Rock, which lies off the southern tip of the Queen Charlotte Islands on the Pacific coast, is another. Other charted dangers include the Roach and Bent Rocks

Hydrographers using sextants for positioning the ship when calibrating the Decca equipment.

The tellurometer is used by a hydrographer to measure distance between survey beacons.



in the Gulf of St. Lawrence, which lie near what was once the main route of ocean-going vessels. Each year, as a result of the work of this Service, scores of hitherto unknown shoals and reefs are located, sounded and recorded on charts.

The hazards mentioned above lie in relatively well-known and well-charted areas compared with the vast northern expanses where, except in the few scattered areas where some charting has been done, ships still move from place to place along the routes followed by those explorers and mariners who first advanced beyond our developed frontiers. The geography and relative inaccessibility of these northern regions would discourage all but the most imaginative and enthusiastic planners and field officers, but as new and modern equipment is made available for Arctic work, and as additional personnel are trained, the task becomes gradually less formidable.

The present staff of hydrographers, together with those of the next generation or two, will contribute greatly to the opening up of these northern areas. However, unless four or five times the present number of survey vessels and six or seven times the present number of trained personnel become available, and unless still greater advances are made in equipment and methods, it will require the work of many generations of Canadians before our Arctic waters are completely charted. The Service anticipates that it may be possible to replace present

At the top of a sheer cliff rising 2,500 feet from the surface of the sea, a survey crew erects a tower. In terrain like this the helicopter is invaluable.

This instrument, the Track Plotter, gives a continuous plot of the ship's track and indicates the position at any given moment. Here, the operator enters the decometer readings in a log book.

A plotting room on a modern hydrographic ship.

A hydrographer transfers depth recordings from graph paper of echo sounder to a field sheet from which a chart will be prepared.

worn-out ships on a scheduled basis and to increase the total number of hydrographic vessels, either by charter or by the construction of new ships. Such new ships, specifically designed for the alternate use of hydrographic surveying and oceanographic research, would serve to meet this urgent requirement of the Department.

Canada is at present the proud owner of one of the largest and most modern hydrographic survey ships in the world, the *Baffin*. This vessel carries a complement of 102 persons, including 20 hydrographers and technicians. She is designed to have a cruising range of 14,000 miles and, during four months in the North last season, sounded round the clock in one area for 32 days and nights continuously. Her electronic positioning equipment (two-range Decca) was set up and "on the air", and sounding operations were begun, in less than 30 hours after the selection of the sites in the survey area had been made. Equipped with six large sounding launches and two helicopters, this ship has the necessary potential to expedite urgent charting requirements in Arctic waters, where the time element is a major factor.

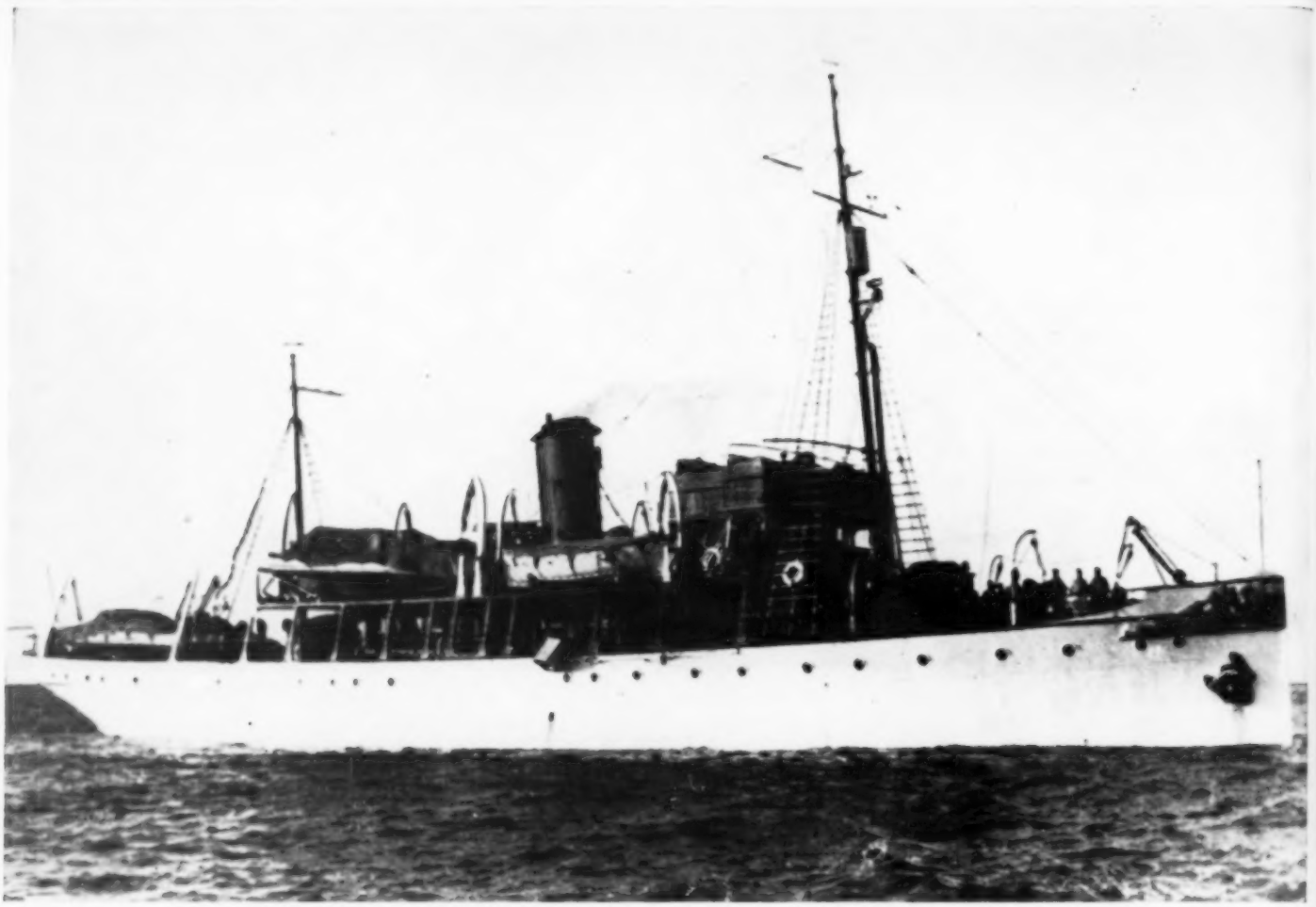
About fifty years ago, Dr. Vilhjalmur Stefansson made what was, at that time, a startling prediction that some day the whole of the North would be colonized; today, if the present trend of events can be taken as an indication for the future, it appears quite probable that industry and settlement may some day reach to our most northern shores. New sea routes and ports for the shipping of ore are even now being planned in the Arctic, and maritime transport in the region is on the increase. When the oil reserves of the northern islands begin to be tapped, the pace of development will be accelerated. Frobisher Bay in the Eastern Arctic, where this Service has been engaged in making hydrographic surveys, was just recently linked to the mainland by telephone, the list of subscribers containing the names of 15 Eskimo families. Some years ago, the commercial port of Churchill was developed, mainly for the transport of grain from the Prairie Provinces to foreign markets. Today, ports for the shipment of iron ore from the Hudson Bay and the Ungava Bay coastal regions are major

A sounding launch returns to the survey ship. Launches such as this are used for inshore sounding.

requirements of the area. In addition, the possibility of an outlet to the sea through James Bay is being investigated. Tuktoyaktuk and Cambridge Bay in the western Arctic are being developed to serve the needs of the increased shipping resulting from the establishment of northern defence installations. All these developments require accurate hydrographic information. In fact, the tremendous transport task involved in the building and maintenance of DEW line sites and the Arctic weather stations would probably have proved impossible without the close and generous co-operation afforded by the United States Hydrographic Office which, together with the Canadian Hydrographic Service, has supplied the information and provided the charts which made it possible for cargo vessels to navigate these waters.

A few years ago it would have been difficult to foresee these requirements or to guess at their extent or implications. Today, with scientific studies being carried out to include all of Canada's most northern territories, and with claims being staked out for the mineral riches of the Arctic islands, the need for increased transportation facilities for the area is constantly growing. The time when there will be an urgent requirement for hydrographic information for submarine cargo carriers in the Arctic may not be too far off. Britain is well advanced with the building of an ore-carrying submarine for northern waters which she expects to have in operation by

Decca slave shore station and mast. This installation is an integral part of the equipment used to position the charting ships for offshore sounding.

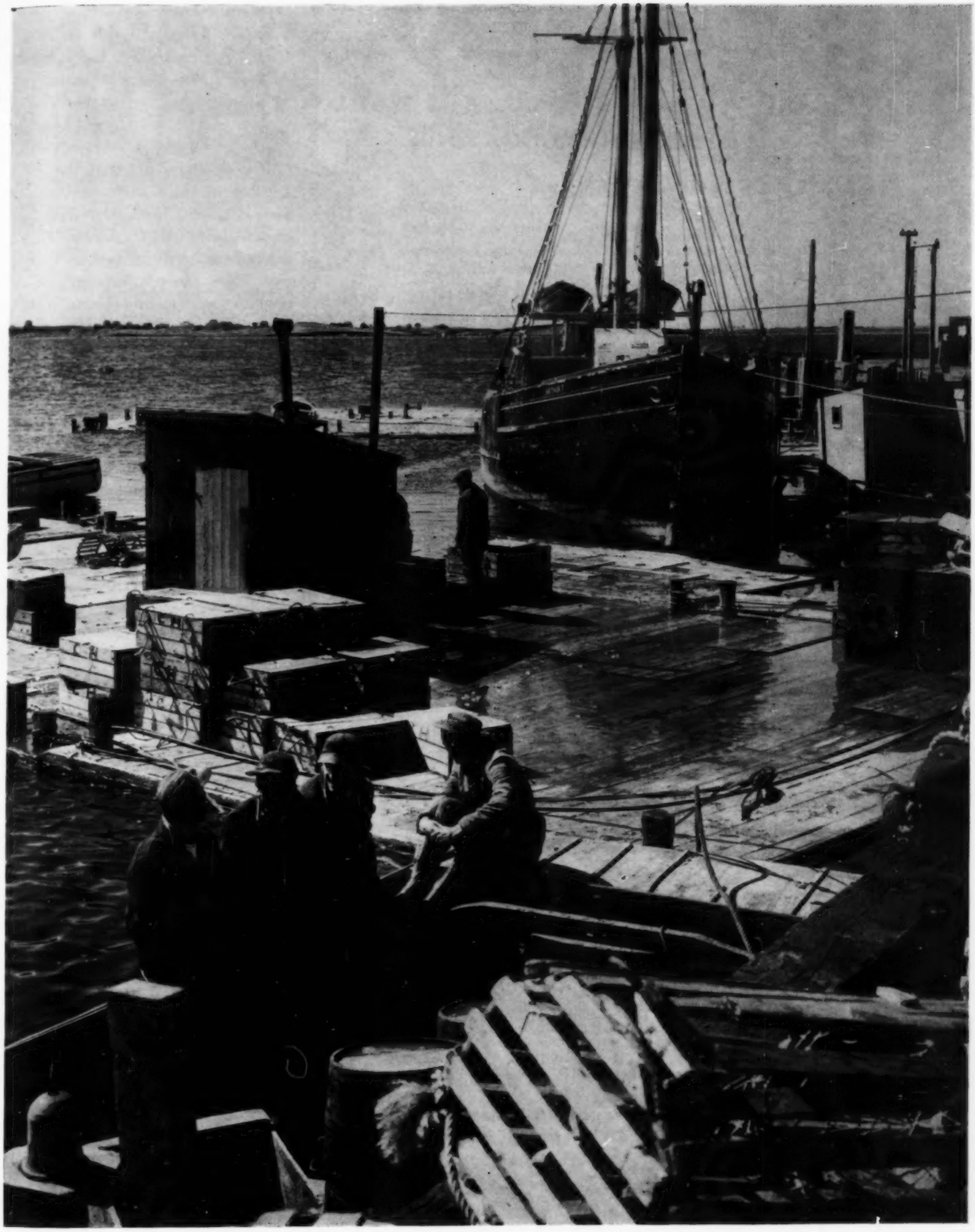


The C.G.S. Acadia, *a veteran ship of the Canadian Hydrographic Service, has seen nearly 50 years of charting service on the waters of Eastern Canada from the Bay of Fundy to Hudson Bay.*

1964, and the United States atomic submarines *Skate* and *Nautilus* have shown that navigation for long distances and prolonged periods under the Arctic ice is possible. Already the ocean depths beneath this ice are being measured and plotted, and plans for more under-ice scientific operations have been announced by the United States and other countries for the future. In keeping with this picture of rapid change, a number of proposals have been put forward in recent months, suggesting means of blocking the southerly flow of cold Arctic waters, thereby extending further northward the moderating influence of the warm currents which enter the area from the Atlantic and Pacific. With all this interest and development, the future establishment of new ports within the Arctic circle appears inevitable.

All such developments increase the amount of sea-borne traffic in the area and intensify the need for reliable hydrographic information in order to promote shipping and ensure safety. The cost in lives, cargo and equipment which the loss of even one cargo vessel represents, is too great to be risked any more often, or any longer, than is absolutely necessary — that is, any longer than the time required to provide ships and trained personnel to chart the routes. The excellence of the work already done by the Canadian Hydrographic Service in northern waters has been proven over the years in the hard, unsentimental light of insurance rates, which have dropped consistently as new charts of the area have been issued by the Service.

From its small beginning in 1883, the Canadian Hydrographic Service has continued to grow for nearly 80 years until, as one of the larger hydrographic services and as a full member of the International Hydrographic Bureau, its work is now known throughout the maritime world. In this day, when man is venturing by rocket and satellite ever farther out into space and descending by submarine and bathyscaph ever deeper into the ocean depths, the work of the Hydrographic Service might be described in words similar to the motto of our Air Force, "per ardua ad profunda".



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EDITOR'S NOTE-BOOK

Frederick A. Curylo (*Drama in the Wilderness*) was born in Kitchener, Ontario, where he still lives. He took his first photographs as a boy at the age of ten, continued to develop his hobby during the succeeding fifteen years and became a full-time free-lance photographer four years ago.

* * *

Jon N. Weber (*Ontario Underground*) graduated from McMaster University with B.Sc. and M.Sc. degrees in geochemistry, and has undertaken field studies for several summers in the Northwest Territories and Alberta. He became interested in caves during six years as an active member of the National Speleological Society. He is currently completing his doctorate research on the geochemistry of dolomite at the University of Toronto.

* * *

Celia Warburton (*Saskatchewan Trappers' Convention*) is a free-lance newspaper correspondent, contributing chiefly to the *Vancouver Sun*, *Prince Albert News*, and *Saskatoon Star-Phoenix*. She has regularly reported on the Saskatchewan Trappers' Convention since its inception.

* * *

Lyn Harrington (*Colonnaded Staffa Island*) is the wife of the free-lance photographer, Richard Harrington. Both, who have travelled very widely, have contributed frequently to the *Canadian Geographical Journal*.

* * *

D. M. LeBourdais (*Vilhjalmur Stefansson*) was born and brought up in the Cariboo district of British Columbia. Beginning at the age of sixteen with the Yukon Telegraph Service as a telegrapher, he tried his hand at a number of occupations before turning to writing. He established the *Canadian Nation*, a fortnightly journal, at Calgary in 1918, transferring it to Ottawa in 1919. After it suspended publication in 1921, he acted as assistant for two successive seasons to Vilhjalmur Stefansson on lecture tours. In 1924, as special correspondent for the North American Newspaper Alliance, he accompanied an expedition to the western Arctic. On Herald Island, off the Siberian coast, the remains of four men lost in 1914 from the *Karluk*, flagship of the Canadian Arctic Expedition, 1913-1918, were discovered. His first book, *Northward: On The New Frontier*, is an account of this expedition. Except for two periods—six years with the Canadian National Committee for Mental Hygiene and five years with the Wartime Prices and Trade Board—he has worked chiefly as a free-lance writer. Since 1950, he has written six books descriptive of Canada and its affairs.

* * *

Stephen R. Titus (*Hydrography in Canada*) is a Maritimer by birth; he joined the Canadian Hydrographic Service over thirty years ago. During this time he has conducted various hydrographic surveys along the Atlantic coast of Canada; in latter years, he has been engaged in administrative and technical work at the Ottawa headquarters, where he presently holds the position of Superintendent of Hydrography.

* * *

AMONGST THE NEW BOOKS

The World: A General Geography
by L. Dudley Stamp
(Longmans, Green and Company, Toronto. 669 pp. $2.50)

The World: A General Geography has long enjoyed popularity as a standard textbook in high schools since it was first published over thirty years ago. The present edition is the sixteenth. The book gives a summary of the whole field of geography in "capsule" form, for it not only deals with general geography (climate, vegetation, soils, etc.), but also regional geography. Indeed, for a brief briefing on any country of the world, or the major regions, one may look between pages 169 and 623.

N. L. NICHOLSON

Dr. Nicholson is Head of the Geographical Branch in the Department of Mines and Technical Surveys in Ottawa.

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Canada's Flying Heritage
by Frank H. Ellis
(University of Toronto Press. 388 pp. $7.95)

In Canadian Skies
by Frank H. Ellis
(Ryerson Press, Toronto. 230 pp. $5.00)

Airborne from Edmonton
by Eugenie Louise Myles
(Ryerson Press, Toronto, 280 pp. $5.00)

Publication of two of these volumes was prompted by the fiftieth anniversary of the first aeroplane in Canada. They are of interest for their own sake and because they furnish an opportunity to draw attention to an earlier and truly remarkable book that has not been noted previously in these pages.

Canada's Flying Heritage calls to mind the works of that indefatigable historian, Hubert Howe Bancroft. Seventy years ago, after publishing more than a score of volumes in which he had recounted the history of the territories, provinces and states that border on the Pacific Coast, Bancroft wrote: "He who shall come after me will scarcely be able to undermine my work by laying another and deeper foundation. He must build upon mine or not at all, for he can not go beyond my authorities for facts. He may add to or alter my work, for I shall not know or be able to tell everything, but he can never make a complete structure of his own." Time has shown that Bancroft's appraisal of his own work was substantially correct; and there is little reason to doubt that in years to come it will become clear that Frank H. Ellis's volume is in the same category. It may be supplemented, but it will never be completely superseded. Both he and Bancroft began gathering information when the developments they later described were just beginning. Both interviewed or corresponded with scores of pioneer figures who gave them first-hand information that no one else had the foresight to secure from them. While engaged in his research Bancroft once said, "Twenty years ago, many parts of our territory were not old enough to have a history; twenty years hence, much will be lost that may now be secured." Mr. Ellis held precisely the same view with respect to aviation in Canada, and with endless patience and persistence gathered countless details before it was too late.

The story is told in detail from the first experiments and flights conducted by Alexander Graham Bell

(Continued on page VII)

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by Professor Dr. *Heinrich Walter* and Privatdozent Dr. *Helmut Lieth*, Botanical Institute of the Agricultural College, Stuttgart-Hohenheim.

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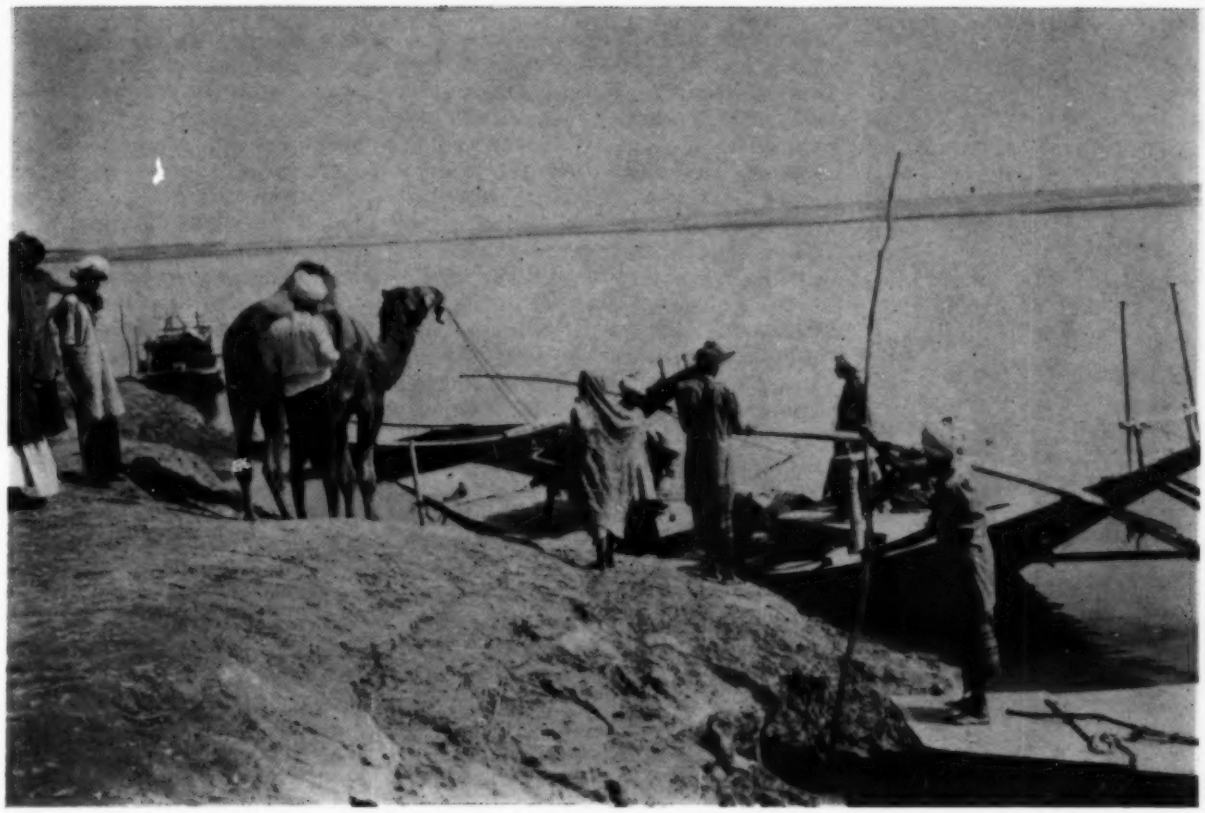

The picture above shows the operation of a primitive ferry service on one of the world's great rivers, the Indus. Rising in Tibet, it flows through Kashmir and West Pakistan, emptying into the Arabian Sea 2,000 miles from its source. In the September issue of the *Canadian Geographical Journal*, R. C. Hodges tells about the scheme that has been developed by India and Pakistan, through the good offices of the World Bank, for sharing the waters of the Indus and its tributaries so as to irrigate a much greater area of the Punjab plain than has been done heretofore. Canada is sharing in this development which will mean so much for the great Indian sub-continent.

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THE
MILDEST
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(Continued from page IV)

and his associates up to the outbreak of the Second World War in 1939; only a few highlights are noted for more recent years. Mr. Ellis has collected photographs as well as information, and the hundreds of pictures in this volume form a gallery of extraordinary interest and historical value. Pictures, indeed, are essential in a history of this kind. To realize this, one has only to read the chapter that describes the two aeroplanes built by a virtually forgotten Canadian pioneer, William Wallace Gibson, in 1910-11; the eight photographs add immeasurably to the record. The lavish use of pictures was made possible by a grant to the publishers by Imperial Oil Limited, and all those interested in the history of aviation owe the company a debt of gratitude.

In a series of appendixes Mr. Ellis gives useful lists of outstanding events, air-mail developments, trophy winners, and so on, and he also includes a note on monuments and museums relating to aviation. It is pleasant to note that when the book is reprinted the fine new Alexander Graham Bell Museum at Baddeck will have to be added to the entries.

In honour of the fiftieth anniversary itself, Mr. Ellis has written *In Canadian Skies*, a shorter volume that (for reasons of price, amongst others) may have a wider appeal to the general public. Greater emphasis is here placed on recent events and modern aircraft, but the excellent illustrations, sixty in number, cover the whole period from the flight of the *Silver Dart* in 1909 to the jet airliners and fighter planes of 1959.

Airborne from Edmonton is a regional history of aviation in Canada that supplements the Ellis volumes and gives much additional information about developments that have centred upon Edmonton. It was not by accident that many of the pioneer long-distance flying ventures touched down at Edmonton, even before anything that could possibly be described as an airport existed there. The location of the city made it both a convenient port of call on many transcontinental and intercontinental flying routes and a logical base upon which to build many of the routes that fan out into the northland. Mrs. Myles deals with all these developments in detail. General Billy Mitchell's aerial expedition to Alaska and Wiley Post's *Winnie Mae* share the pages with the exploits of such well-known Canadian air pioneers as Wop May, Punch Dickins and Grant McConachie. As in the other two books, excellent illustrations add much to the attractiveness of the volume.

In spite of the arrival of these three books, there would seem still to be room on the shelf for another volume devoted primarily to types of aircraft that have made their mark in Canada. The famous Curtiss JN4 (Jenny), for example, receives attention and praise from both Mr. Ellis and Mrs. Myles, but neither has the space to deal with the machine itself, and tell us all we should like to know about its design and capabilities. Nor, perhaps, is sufficient emphasis placed on the importance of the fact that the durable Jenny, thoroughly tested and proven during the First World War, happened to be available when serious interest in flying—and particularly in commercial flying—first arose in Canada.

W. Kaye Lamb.

Dr. Kaye Lamb is Dominion Archivist and National Librarian at Ottawa.

* * *

Anerca

Edited by Edmund Carpenter

(J. M. Dent & Sons (Canada) Limited, Toronto. 48 pp. $2.75 hardcover; $2.00 paperback).

"In Eskimo the word to make poetry is the word to breathe; both are derivatives of *enerca*, the soul, that which is eternal: the breath of life. A poem is words infused with breath or spirit: 'let me breathe of it', says the poet-maker and then begins: 'I have put my poem in order on the threshold of my tongue.' " Unlike its Amerindian counterpart, Eskimo poetry is almost entirely unknown to us palefaces, and Edmund Carpenter has had the good idea of collecting and translating some examples from the Canadian Arctic. They tell of the hunt and the landscape, of life and love, of despair and death; and they vary in form from the prose-poem to the simplicity of what is remarkably like the Haiku of Japan. They are printed on generous areas of ice-grey paper, interspersed with delightful vignettes drawn nearly fifty years ago on Baffin Island by Enooesweetok and preserved by Robert Flaherty the movie-maker.

N. T. Gridgeman

Mr. Gridgeman is a statistician in the Applied Biology Division of the National Research Council at Ottawa.

* * *

The Prentice-Hall World Atlas

Edited by Joseph E. Williams

(Prentice-Hall Inc., New York. $9.00)

European cartographers and the skills of their assistants have become bywords among map users everywhere, and it is noteworthy that their techniques are now being employed by American publishers. In this atlas, the final work of preparing the ninety-six pages of 158 maps was carried out in the *Geographisches Institut und Verlag* in Vienna, Austria, under the distinguished direction of Dr. Hugo Eckelt. The outstanding feature of his technique is that it gives the terrain or relief maps an almost perfect three-dimensional effect. In addition, the styles of type used for the names, and the other lettering, have been so judiciously chosen that they are remarkably clear and readable, even in crowded areas.

But the worth of an atlas should properly be measured by its subject matter and its accuracy, rather than the techniques used to depict the data. The first quarter of this book consists of world maps and the remainder of maps of continents and regions. Nine plates are devoted to the physical aspects of the world—relief, climate, soils, geology and vegetation—while the rest of the series is economic, showing the global distribution of minerals, crops and domestic animals, with pie-graphs indicating the proportions which the major producing countries contribute to the world total of each commodity. The approach to each continent is

similar. The blend of physical and economic maps is not only useful and obviously planned most carefully, but is also very attractive visually.

There is only space for one plate devoted exclusively to Canada. This shows a map on a scale of 1:12,500,000. As is so often the case, the whole country is not depicted, and the Queen Elizabeth Islands have been omitted. The time which it takes to produce atlases is also evidenced by the fact that Burnt Creek is shown, when it has long since fallen victim to the iron-ore mines, while Schefferville is not indicated at all. The perennial error of "Athabaska" spelled with a "k" is also in evidence, and it is unfortunate that the end of "steel" in Western Manitoba terminates in the wilderness, when it could so easily have been labelled Lynn Lake.

But Canada also appears on seven smaller maps of North America and here also there are a few points which puzzle the Canadian reader. The use of the archaic term "Grant Land" in northern Ellesmere Island is one. On the two population maps, Eskimos are shown in areas which would best have been included in the category of "nearly uninhabited". On the ethnographic map the appearance of the word Ten'a in northwestern Canada, as a division of the Indians, is a complete mystery!

N. L. NICHOLSON

Dr. Nicholson is Director of the Geographical Branch of the Department of Mines and Technical Surveys at Ottawa.

* * *

A Regional Geography of Western Europe

by F. J. Monkhouse
(Longmans, Green and Company, Toronto. 726 pp. $9.00)

This is the latest book in the Longmans series of Geographies for Advance Study, and the fact that it runs to 746 pages is therefore to be expected. But the amount of detail which it contains is more evident from this statistic when it is realized that the book deals with France (less Corsica) and the Benelux countries only. This is not a common application of the term "Western Europe", even by geographers, and it might have been better to have used a more accurate title. Such a title would also have been in keeping with the substance of the text in which Professor Monkhouse has faithfully recorded an immense amount of material.

The organization of the work is also somewhat unusual in that the regional studies are "based on major structural and physical units". This approach, however, although it will undoubtedly find favour in the eyes of many Canadian (and American) geographers, does not provide for "a regional study of each of the four sovereign states as individuals" and hence offers little scope for the examination of human and cultural factors.

This work is in three parts—The Lowlands, The Hercynian Uplands and The Fold Mountains. The chapters within these parts represent the second tier in the heirarchy of regions and the chapters themselves are further subdivided into sub-regions and sub-sub-regions. Based as it is on many years of field work by the author, this book cannot but be regarded as a standard reference for the fundamental framework of the geography of the area for a long time to come. No small contribution is provided by the excellent photographs —some sixty-four of them—and the 141 sketch maps and diagrams which are well-drawn, economically conceived and to the point.

N. L. NICHOLSON

Dr. Nicholson is Head of the Geographical Branch in the Department of Mines and Technical Surveys in Ottawa.

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